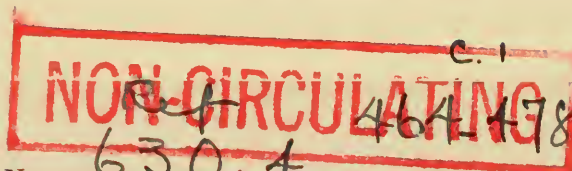


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TOMATO PLANTS

FOR

THE PROCESSING INDUSTRY



A. N. L. BUTLER

HORTICULTURAL EXPERIMENT STATION
VINELAND STATION



ONTARIO DEPARTMENT of AGRICULTURE
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THE PRIMARY NEED



The profitable production of field tomatoes for processing demands that contract growers produce and market high-quality crops of considerably better than average yield. A prime necessity for such production is the use of good plants.

An appreciation of what constitutes a desirable tomato plant for field setting is gradually being developed. None-the-less a wide difference of opinion on this point still exists in the minds of many plant growers, processors, fieldmen and contract growers. Many plant producers quite understandably have difficulty in producing good, uniform plants owing to a lack of proper equipment, suitable soil, and a satisfactory growing technique. One sometimes wonders whether, under such conditions, opinions expressed relative to the best type of plant for field setting may not represent an effort to justify the use of plants which have been produced.

Contract growers are currently pressing for the grading of tomato plants and it is just possible that this may be necessary. Closer attention on the part of many plant growers to factors such as the preparation of a suitable soil and to the control of disease would, however, go far toward overcoming much of the criticism now attributed to domestically produced plants.

This bulletin offers guidance in the many factors which contribute to the production of suitable plants. These factors include seed, soil and its preparation, the composting of soils, disease control, plant-growing structures and equipment, and transplanting and other production practices.

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TOMATO PLANTS

FOR THE PROCESSING INDUSTRY

THE PLANT INDUSTRY IN ONTARIO

The production of tomato plants in Ontario for the processing industry has followed much the same pattern as the production of contract tomatoes. While tomatoes have been processed since approximately 1870, wartime and post-war demands for food necessitated tremendous increases in the acreage of this crop and in the production of the necessary plants. Accurate data for the province as a whole are available only since 1941. These data show, that while there was a reasonably consistent increase in the production of processing tomatoes from 1941 to 1948, the most spectacular increases took place in 1946, 1947 and 1948. The acreage harvested in 1948 was 47,150.

In the early days of the tomato processing industry all tomato plants were grown in close proximity to the contract acreage. In recent years, however, tomato plants produced in the United States of America have been imported in very considerable numbers. While importations have not exceeded possibly 10 per cent of our requirements the importations do represent a threat to domestic plant production.

In Ontario more than 380 plant growers produce tomato plants and/or seedlings commercially for the processing industry. In addition to these plant growers a very considerable number of tomato contract growers grow or purchase seedlings and finish their own plants. It has been estimated that during 1948, the peak production year, commercial plant growers in Ontario produced approximately 127,000,000 tomato plants. At an estimated average value of \$5.50 per thousand this represented an industry worth approximately \$700,000.00.

Since considerable hand labour is involved in the production of tomato plants many hundreds of men and women workers benefit through seasonal or prolonged employment. With many plant growers the production of tomato plants is a major farm enterprise. In the case of others, plant production fits into the farm operation enabling fuller utilization of equipment and labour. Plant production in eastern Ontario is engaged in by many growers although the bulk of the plants are produced by processors. While a very considerable inventory is involved, the plant production enterprise enables processors to employ more help on a twelve-month basis.

Domestically produced plants, *provided they are well grown*, are considered to offer certain advantages over plants imported from the south. It is hoped that this bulletin may assist plant growers to produce better plants and thereby to retain a very worthwhile industry in this province.

THE IMPORTANCE OF GOOD PLANTS

Good plants are essential for the production of high acre-yields of processing tomatoes and high acre-yields are necessary for profitable production.

Unlike many other crops which mature fruit readily in northern latitudes, the tomato is a heat-loving crop and can be produced, profitably, only in those parts of the province which have a relatively long frost-free period. It is for this reason that the industry is limited to those areas of southern Ontario bordering on Lake Erie and Lake Ontario south of a line from Wallaceburg to Toronto; to a narrow strip of land adjacent to, and north of, Lake Ontario extending as far east as Napanee; and to a very limited area south of Georgian Bay around Collingwood.

Since we are located on the northern fringe of the area where the tomato crop can be successfully and economically produced, advantage must be taken of every factor which will encourage early development and maturity. One of the most important such factors is the use of good plants.

THE TOMATO PLANT SITUATION IN ONTARIO

Tomato plants produced in Ontario have been subject to criticism on the part of processors and contract growers for many years. Some of the plants measure up to the most critical demands. Too large a proportion of the production, however, falls very much short of what it should be. In fact poor plants are considered to be a major contributing factor in the low per-acre yield of field tomatoes in Ontario. Records for the past nine years show the average yield to be 6.0 tons, or 200 bushels per acre.

Among the criticisms most frequently attributed to plants produced in south-western Ontario are: Lack of uniformity in size of plant within and between bundles; late delivery in backward seasons; and, where plants are shipped by transport, damage caused by heating. Criticisms levelled against plants produced in central and eastern Ontario include: Late delivery; lack of uniformity in size of plant within flats, and between flats; less than specified number of transplantable plants per flat; excessive number of non-transplantable plants per flat; delivery of inadequately hardened plants which are often tall and leggy; delivery of diseased plants; and lack of a vigorous root development.

THE CHARACTERISTICS OF GOOD PLANTS

The ideal plant is not always produced even by the most experienced growers. Nevertheless certain plant growers produce, year after year, plants which meet the most exacting demands of processors and contract growers.

The characteristics of good plants include the following:

1. The variety should be acceptable to the processor and adapted to the area where the crop is to be grown.
2. Plants should be true to a productive strain of the selected variety.
3. Plants should be stocky and from 6 to 10 inches in height when they leave the nursery.
4. Plants should have stems which are at least one-quarter inch in diameter about two inches above ground level.
5. All plants within a given lot should be reasonably uniform as to size.
6. Plants should have reasonably straight stems which are firm but not hard.
7. Plant stems should show some purpling up to the second or third node.
8. Plant foliage should be a good normal green in colour.

9. Roots should be vigorous and well developed.
10. Plants should be free from disease. This applies to both tops and roots.
11. Plants should be ready for field setting when danger from frost is past.
12. Bundles of plants for shipment by transport should be wrapped in a manner and shipped under conditions which will discourage heating and the development of foliage diseases.

SEED AS A FACTOR IN PLANT PRODUCTION

Seed is an important factor in the production of maximum yields of high quality tomatoes. Seed is, therefore, an important factor in the production of good plants.

Choice of Variety and Strain

Growers of contract tomatoes are usually dependent upon processors or plant growers for their plants and for the choice of seed with which to establish these plants. The responsibility assumed in the choice of variety, strain, and source of tomato seed, cannot be over-emphasized since the inheritance bred into the seed may determine the success or failure of the contract-grower's crop.

The seed used to produce tomato seedlings should be true to a variety which is acceptable to the processor and adapted to the area in which the crop is to be grown. These characteristics are of much greater importance than high germination. Too often plant growers compare the merits of different lots of seed on the basis of stand or strong germination. Regardless of its germination, seed is poor if it produces a crop which lacks uniformity, or a crop which will not, in a normal season, mature a satisfactory crop before the first killing frost.

Source of Seed

Most of the seed used by plant growers is supplied by three Ontario establishments specializing in tomato seed production. A limited but increasing quantity, especially of the newer varieties, is procured from Canadian and American seedsmen. In addition, seed for their own requirements is saved by a few plant growers who believe that they possess superior strains of popular varieties.

A few years ago it was not uncommon for processors to salvage seed from their factory operations. Even yet a few processors are known to save seed from a particularly good looking load or field of tomatoes. This practice is of course neither safe nor sound and is not followed by progressive canners.

The production of tomato seed should be the responsibility of those who are trained and experienced in this specialized phase of seed production. Good seed can be saved by growers who are careful and observant, and who follow certain recommended practices. More often than not, however, seed saved by amateurs is not saved according to well planned procedures and cannot be considered as good seed.

Poor seed is expensive at any price. The cost of good seed is so small an item in the cost of producing an acre of tomatoes, and the influence of good seed upon production is so great, that only the best seed available should be used. With seed at six dollars per pound, less than forty cents will purchase seed sufficient to establish an acre of tomatoes.

Good seed implies that seed has been saved from approved crops of adapted, acceptable varieties, and that care has been exercised to avoid contamination during all production and marketing operations. In this connection users of seed can be assured of the pedigree and performance of their stocks by demanding seed sealed as registered or certified. Growers of seed can in turn supply this demand by availing themselves of the service of crop registration as provided by the Canadian Seed Growers Association; and the service of crop certification and seed sealing as provided by the Plant Products Division, Production Service, Canada Department of Agriculture, Ottawa.

Comparative tests have not only demonstrated differences between varieties but also between strains of the same variety, with respect to yield, earliness, uniformity, quality, and disease resistance. Desirable characteristics, although often not readily discernible, are bred into superior seed stock. If those who assume responsibility for seed-stock maintenance and multiplication fail to exercise the necessary skill and care, then the time, effort, and expense put into the production of new and improved sorts are all in vain. In like manner those who assume responsibility for tomato-plant production have a definite responsibility to tomato contract-growers in respect to seed stocks used.

The objective of seed growers should be the maintenance and multiplication of stocks under conditions which will safeguard their purity and performance. Variety or strain improvement is properly the responsibility of the plant breeder. Many acceptable seed stocks have, in the process of "improvement", been so changed that they have failed to give consistent performance in the hands of contract growers. This happens when producers of seed who lack the necessary facilities, experience and know-how, undertake a plan of "stock improvement" in conjunction with their seed-multiplication enterprise.

SOIL AS A FACTOR IN PLANT PRODUCTION

Many of the troubles experienced by tomato plant growers are traceable to the soil in which the plants are grown. This was confirmed in 1947, when a survey was conducted in Ontario on soils used to produce tomato plants for the processing industry. Of the 120 representative soils or composts sampled, only 19 per cent carried a normal level of total salts. On the other hand 21 per cent carried an excessively high or toxic level of total salts.

Characteristics of Good Plant Soil

A good or granular structure is the primary requirement of a soil for plant production. Nutrients are essential but can be added if and when necessary during the development of the plant.

Soil of good structure is characterized by good aeration, good drainage, and a high water-holding capacity.

Aeration — Plant roots require oxygen for growth. A soil should therefore have a large amount of pore space to allow oxygen, which is a component of air, to penetrate to the roots. By pore space is meant that portion of any given volume of soil which is unoccupied by solid particles, i.e. the cavities between particles. Sandy soils have larger air spaces than clay soils because the individual soil particles are larger. The need for oxygen is clearly shown by the fact that plants growing in soil-less cultures or tanks containing nutrient solutions must have air continuously pumped into the nutrient solution. If for any reason this air is withheld for a period of only a few hours the plants will wilt, certainly not from lack of water but from lack of oxygen.

Drainage — Good drainage is the ability of a soil to permit excess water to be removed freely. Soils which are well aerated are usually well drained. The larger the porespace the more readily is excess water removed from the soil. That is why soils with a high sand content require very frequent watering. Clay soils, having relatively small particles, remain sodden and compacted, especially when lacking in organic matter.

Water-holding Capacity — Organic matter contributes water-holding capacity to soils. Organic matter, acting as a sponge, absorbs and holds the moisture which is so necessary for plant growth. Composts must, therefore, carry sufficient organic matter to impart a granular texture to the soil and thereby to provide the proper air — water relationship.

Adequate Nutrient Level — The optimum nutrient level for a soil is influenced by the method of plant culture. It is possible to produce good seedlings by supplying all of the nutrients in liquid form, provided the soil or growing medium has a satisfactory structure. This has been clearly shown by the production of tomato plants in sand, sand and peat, and in vermiculite. Vermiculite does not contain any nutrients but has an ideal structure for plant production since it provides excellent aeration for the roots, permits excess water to drain off freely, yet has a very high water-holding capacity.

Tomato plants do not normally remain in the nursery longer than 4 to 5 weeks. Consequently it is general practice, more particularly where flat culture is employed, to use composted soils holding sufficient nutrients to carry the plants until they leave the nursery.

Preparation of Soil for Plant Production

Tomato plants for the processing industry are produced in Ontario by two principal methods. Owing to a favorable combination of climate and soil a production centre has developed in south-western Ontario, around Leamington, where plants are grown in field beds and pulled for delivery to contract growers. Soil preparation for this type of tomato-plant production naturally differs from that where plants are grown, finished and delivered to contract growers in flats.

Field Culture — Good drainage is very important. A well-drained sandy or sandy-loam soil is recommended. The site should preferably be sheltered by a windbreak or by buildings. Land preparation should aim to develop a suitable soil structure and to incorporate some soil nutrients, especially phosphorus. Additional nutrients can always be added as required.

Most soils currently being used for plant production are too low in organic matter. Present methods of maintaining organic matter, which usually employ manure and cover crops of corn and rye, apparently are not adequate. Research conducted by the Campbell Soup Company Ltd., in the Leamington area, has demonstrated that better plants can be produced where the organic-matter content of soils is substantially increased.

The tomato-plant nursery should follow a crop of well-fertilized bluegrass or clover. Apply 20 to 40 tons of manure, 100 pounds of ammonium nitrate or its equivalent, and 1000 pounds of superphosphate per acre, on a good growth of meadow. Plow in late August, work the land well to break down the sod, and sow to rye.

By plowing the sod in late summer the fibrous material will be decomposed prior to setting tomato seedlings. The rye will protect the soil by reducing

erosion, will contribute some organic matter, and will avoid excess leaching of soil nutrients during the winter months. Plow the rye in early spring and fit the land for tomato seedlings. Rototillage equipment is useful to fit soil just prior to setting seedlings.

Flat Culture — The production of tomato plants in flats involves the preparation and handling of a large volume of soil. Where production is relatively small, soil may be produced by composting methods. For large scale production, soil is generally produced by a combination of field preparation and composting. Suggestions for the preparation of soil by both methods are given in the accompanying general discussion on the composting of soil.

COMPOSTING SOILS

An adequate level of nutrients as well as a satisfactory soil structure can be attained by composting methods. By composting is meant the preparation of soil, many months in advance of its intended use, under conditions favorable for the micro-biological and chemical changes which produce a soil of good structure and one which will contain nutrients in forms and quantities which are non-toxic, yet readily available for plant assimilation. In soil composting the following factors are important:

Location

Convenience to greenhouse and transplanting shed usually determines the location of the compost pile. The site should, however, be well drained. If possible, place the compost pile on a slight elevation so that soil may be moved on gravity conveyors to the sterilization pit and/or transplanting shed. Sufficient space should be provided for at least two or three years' soil requirements. It is desirable to provide a shelter for the compost, following grinding in the fall. Soil will then be readily available for use. Exposed piles become leached of nutrients by rain, and often become frozen. Such soil usually lacks uniformity.

Construction

Compost piles should be built from six to eight feet wide, about four feet high, and as long as is necessary to provide the required volume of soil. It is advisable to moisten and to lightly tramp the pile as each layer of soil is added. This will serve to make it firm and to bring about conditions more favorable for micro-biological activity. Properly constructed compost piles have straight sides and a dished top.

A fault commonly observed in plant growers' "dirt piles" is that they have been thrown together rather than built. Their rounded tops serve to shed much of the rainfall with the result that the interior of the pile is too dry for proper micro-biological activity. Soil from such piles is not properly composted, is often partially leached, and is usually lacking in uniformity.

Component Materials

In the building of compost piles alternate layers of a good deep sod and horse manure, with added superphosphate, are used. Avoid using cow or pig manure since they contribute toxic quantities of soluble salts. Sand may be added as required, depending upon the type of soil from which the sod was secured. Manure, like most Ontario soils, is low in phosphorous. Superphosphate should therefore be spread on top of each layer of manure at the rate of two pounds per cubic yard of compost.

While this time-tested method of compost production is still employed by a few plant growers, the scarcity of manure and, in some areas, the scarcity of good sod, has driven most growers to employ substitutes for either or both the sod and the manure. Substitutes currently being used include black muck, peat, leaf-mould, mushroom compost, pea silage, the manure and straw from plant beds, topsoil, grape pomice, and sand. These materials are presently being used, singly or combined, with varying degrees of success, depending upon the period of time certain ingredients have been composted, the structure of the resultant mixture, and upon the ability of the operator to recognize the need for and to provide supplementary plant nutrients. Other ingredients currently being added by some growers include cyanamid, sheep manure, complete fertilizer and superphosphate.

Manure should always be composted before use. The consistency of manure now varies so much, depending upon the source from which it is received, that it is difficult to recommend ratios for manure and soil. A rough strawy manure is preferred for composting with a heavy type of soil. If light-textured soils are used the manure should be more broken down. Badly composted manure contributes relatively little in nutrients. Well-composted manure will contribute about 0.5 per cent nitrogen, 0.25 per cent phosphoric acid and 0.25 per cent potash.

Leaf-mould is considered a very satisfactory source of organic matter for composts but, like manure, is somewhat variable in composition. Mushroom compost, when available, is an excellent source of organic matter.

Cyanamid must be used with caution. If composts containing cyanamid are not watered during a dry summer the poisonous gas may not be dissipated, and may, when the soil is used, cause injury to plant growth. Properly used, cyanamid, like any other form of nitrogen, stimulates the breakdown of the fibrous components of the compost. Cyanamid also kills weed seeds and contributes lime to the compost.

Peat moss may be used to contribute organic matter to compost soils. Moss has little or no available nutrient value but develops a very desirable soil structure. Therefore, where peat moss is used it will be necessary to add nutrients. This may be done when the compost is finally being prepared for use; or the nutrients may be added from time to time as required, during plant growth.

The John Innes Horticultural Institution, in England, has developed a peat-moss formula for composting soils which has proven very satisfactory. It is as follows:

7 parts medium field loam
3 parts peat moss
2 parts sharp coarse sand

If a heavy soil is employed the ratio would be 8:2½:2½ respectively. This formula gives a soil of perfect structure but one which is low in nutrients.

Micro-organisms

Micro-organisms serve to break down the organic-matter content of composting soils. We are all familiar with their action in the heating of manure. If compost piles, by virtue of composition, are considered to lack micro-organisms, a small quantity of horse manure should be added for inoculation purposes.

For proper micro-biological activity, compost piles should be moist but not sodden. In seasons of insufficient rainfall it will be necessary to dampen the pile at intervals during the summer. Applied to the top as a fine spray, the water will soak in and wet the compost uniformly. The pile should never be so wet that water runs from the bottom.

A combination of warmth and moisture is necessary for micro-biological activity. Composts should, therefore, be built in the spring so that the micro-organisms may be encouraged to work during the summer months when nature provides the warmth and, usually, the moisture.

Too often soil for early spring use is not prepared or piled until late the previous summer or autumn. Under such conditions micro-biological activity is impossible or of too short duration for the production of suitable compost.

Time as a Factor

In addition to a favorable environment, the micro-biological and chemical changes which take place during compost production require time for completion. The use of insufficiently "cured" compost is a common cause of trouble. Most of the stunting and a great deal of so-called "damping off" is, in fact, caused by toxic quantities of nitrites, chlorides, and sulphates. These toxic properties are dissipated when compost is aged.

Soil used for plant production should have been actively composting for at least one year. It will be better if soil has composted for two or three years. All that is required to have two-year-old compost available at all times is to start by putting up at least two years' requirements and thereafter adding one years' supply each spring.

Uniformity

Lack of uniformity in respect to plant size, even within any given bundle or flat, is one of the most bitter criticisms levelled against tomato plants delivered to contract growers in Ontario. Much of this lack of uniformity can be attributed to lack of uniformity in the soil. The fact cannot be emphasized too strongly that uniformity is necessary in the compost if uniformity is to be achieved in plant development.

Compost piles should be turned at least once and preferably twice prior to use. A combination of turning and grinding is even better. Turning, or turning and grinding, serves to make a compost more uniform, to break up clods and, at the same time, permits the outside of the pile to be moved to the centre where sod and other fibrous materials will have an opportunity to break down. If a spade is employed to cut the pile in slices from top to bottom, material from the component layers will be distributed throughout the mass, and greater uniformity will be achieved.

Soil Testing

A representative sample of compost should be taken when the soil is ground. For the convenience of plant growers a soil-testing service is operated by the Department of Horticulture, Ontario Agricultural College, Guelph, Ont., where samples may be sent for analysis. A soil analysis will indicate whether additional nutrients are required or whether excess soluble salts present a problem.

Field Composted Soils

Practices vary greatly in respect to procurement and preparation of soil by this method. Currently, many plant growers develop dirt piles composed of straw with manure which has been permitted to rot in hot beds and cold frames during the summer months, together with sand and top-soil from roadways, headlands or ditch bottoms. Provided the soil is not to be used for two or three years, this practice should give a compost of satisfactory physical structure and one which will not contain excess soluble salts.

Where soil sterilization is not practised it is much better to use soil which has not grown tomatoes or related crops for at least four years. Soil and straw or manure from flats, beds or other plant-growing structures is likely to harbour disease and should not be incorporated into soil for plant production.

Suitable soil may be secured by removing the top six inches from a field which has been especially prepared for the purpose. While this method was formerly considered rather costly, front-loading equipment for tractors has now made it quite feasible. Select land which has not grown tomatoes or related crops for at least four years, and on which a good, deep, well-fertilized grass or mixed grass and clover sod is established. Apply 20 to 40 tons of manure and 1000 pounds of superphosphate per acre. Plow to a depth of six inches. Test for acidity and add ground limestone if necessary. Fit the land and sow to soybeans or some other legume crop in late May. Plow the legume crop while in full pod, and sow to rye. Blue grass may replace rye in a three-year programme. Plow the rye in spring, haul the soil to a location convenient to the plant-growing establishment, and pile.

Soil should be turned and screened, preferably twice, prior to use. Depending upon the analysis of samples taken when the soil was turned in the fall, nutrients may be added in the form of a complete fertilizer, when grinding the soil for use. If a coal elevator is used to pile soil following the screening operation, greater uniformity will be achieved. To avoid leaching of nutrients and to keep soil available for immediate use, the piles should be covered during the winter months.

DISEASE CONTROL

Disease takes a heavy toll each year from growers of tomato seedlings and plants, and from growers of contract tomatoes. Damping-off fungi may, and do, cause losses in plant-growing establishments, affecting the growth and/or the merchantability of the plants. Several diseases, however, which have their inception in the nursery, may not cause any appreciable loss until the tomato crop is established in the field. While spectacular field losses may occur only at infrequent intervals, contract growers are subjected to annual losses of considerable magnitude because of reduced yield, lowered grades, or both.

The extent of field losses attributable to disease has not as yet been fully appreciated. None-the-less, processors and contract growers are becoming increasingly conscious of the necessity for setting good plants. Since freedom from disease is an important attribute of good plants, plant growers may find it increasingly difficult to secure a production contract unless sanitary and protective measures are adopted for the control of disease. The future prospects of the tomato plant-growing industry in Ontario may, in fact, be dependent upon the ability and the willingness of plant growers to produce and to deliver disease-free plants.



Fig. 1. Weeds should not be tolerated around plant-growing structures. Note the new spring growth, and stems of last season's weeds.

Diseases which affect tomato plants in the nursery are of three main types; parasitic, non-parasitic, and virus. Parasitic diseases are caused by fungi or bacteria. Non-parasitic diseases are attributable to faulty environment such as nutrient deficiencies, toxic quantities of soluble salts, smoke, and the fumes or spray of 2,4-D. The third group, the virus diseases, are caused by one or more of several viruses.

Diseases of the non-parasitic group are not infectious and should not present a problem in efficiently managed plant-growing establishments. In contrast, virus diseases are highly infectious, and those caused by fungi and bacteria may spread rapidly under conditions favorable for their development. Since parasitic and virus diseases may attack tomato plants at any stage of their development any programme for their control must have as its objective the prevention of infection.

Eliminate Unsanitary Environment

Many perennial weeds which abound around farm buildings, plant-growing structures and fence lines, are often afflicted with the same diseases which attack the tomato. Weeds and debris may not only harbour destructive diseases but also insects which serve to spread them to tomato plants. Conditions in and around the plant-growing nursery should, therefore, be clean and sanitary. Catnip, motherwort, milkweed, nightshade, and ground cherry are particularly objectionable since they often carry the virus which causes cucumber mosaic in tomatoes. The common burdock, while of lesser importance, may harbour the same virus. Common plantain has been shown to harbour one phase of the tobacco mosaic virus which causes internal

browning or ring spot of tomatoes. The horse nettle is said to be a weed host for the fungus which causes Septoria Leaf Spot. One of the first steps in the prevention of disease therefore, should be to eliminate all weeds in close proximity to tomato plant-growing establishments. Soil, sod, or cinders in and around plant beds and structures should be kept free of weeds.

The virus which causes tobacco mosaic may be transferred to tomato plants from a wide range of ornamental bedding plants and vegetables such as petunia, snapdragon, zinnia, larkspur, fox glove, morning glory, swiss chard, spinach, carrot, pepper, eggplant, potato, tomato, and green refugee beans. These plants, therefore, should not be present in tomato plant-growing establishments. Tomato-plant growers who require a few flats of ornamentals or early vegetable plants should aim to purchase their requirements or to exchange a few flats of tomatoes with neighbours who cater to the ornamental and vegetable-plant trade.

Once present in a plant-growing establishment a virus may be spread by insects or by man. During the transplanting operation plant juices on the hands of workers may serve to spread infection. The brushing of plants by clothing when working in crowded houses and beds may also serve to spread infection.

Another source of mosaic is from smoking and chewing tobacco. Since the virus is known to survive even in processed tobacco, workers should not use tobacco while working around tomato plants. Workers who must use tobacco should wash their hands with soap and water before resuming work.

Tomatoes are very susceptible to injury from the chemical weed-killer 2,4-D. Each year an increasing number of instances of this form of injury are investigated. Sometimes a sprayer which at one time had contained 2,4-D, was used to spray tomato plants. Sometimes drift from weed-spraying operations nearby gained access to the greenhouse or bed. Even fumes or vapour given off by some forms of 2,4-D can cause damage. Precautions must, therefore, be exercised to avoid injury. If 2,4-D is used for control of weeds in proximity to plant-growing establishments, spray during summer months when structures are empty. Sprayers which have been used with 2,4-D are difficult if not impossible to clean thoroughly and, under no conditions, should they be used for the application of fungicides on tomatoes. In this connection knapsack or hand sprayers, while satisfactory for weed control, do not have sufficient pressure for the efficient application of fungicides.

Seed Treatment

There should be no danger of virus infection from tomato seed which is at least six months old. Newly saved tomato seed may, however, carry the virus which causes mosaic.

Many fungus and bacterial diseases of the tomato survive on the seed surface or within the seed tissues. If not destroyed before seed is sown these diseases may invade the young seedlings in the early stages of their development. Many seedlings are, in fact, killed by disease before they break ground. Stands, reduced in this manner, are often blamed upon seed of poor germination.

Tomato seed should therefore be treated before sowing, using a combination of hot water and a fungicidal dust protectant. The hot-water treatment will

destroy diseases both on and within the seed. The fungicidal dust will give young seedlings a measure of protection against soil-borne infection.

Hot water — Immerse seed into hot water 122°F. (50°C.) for 25 minutes, wash immediately in cold water and dry. *An accurate thermometer is essential since the lethal temperature is very close to that required for disease control.*

Seed may be hot-water treated at any time prior to sowing. The most desirable time however, is shortly after it has been saved and dried. Newly saved seed is usually strong in vigour and early treatment permits a check on the germination of each lot. By using dry seed, rather than newly washed seed, the problem of maintaining the temperature required for seed treatment is simplified.

For treatment, seed should be wrapped loosely in cheesecloth or open-mesh cotton bags. Several containers, each holding 2 or 3 pounds, are preferred to one larger bag containing 20 or 30 pounds. For best results cotton containers should previously have been wetted. This softens the bags and reduces the time required for complete penetration by the hot water. After immersion, seed containers should be gently agitated until seed is thoroughly wetted. A weighted rack placed upon the seed containers will keep them completely submerged during the treatment.

The volume of hot water used should be relatively great in relation to the volume of seed to be treated at any one time. This simplifies the problem of maintaining the necessary temperature. While any large metal tank is suitable, a canning factory retort is ideal because of the mass of its metal and the volume of water which it contains. Some sort of agitator is necessary to keep water at a uniform temperature. If the tank contains an electric heating unit or a steam inlet, some sort of rack or guard should be provided so that seed containers will not come into contact with exceedingly high temperatures. Electric heating devices should be thermostatically controlled.

The hot-water seed treatment usually lowers the germination from 3 to 5 per cent depending upon the vigour of the seed. This may be considered an advantage, however, since the weakest seeds are killed, and these would produce only weak seedlings and weak plants.

Responsibility for the hot-water treatment should rightfully be assumed by the seed producer. It is much more difficult for individual plant-growers to treat small lots of seed with the facilities which they might have at their disposal.

Fungicidal Dust Protectants — Seed protectants such as Arasan should be used as recommended by their manufacturers.

Small lots of seed may be treated by shaking the seed and fungicidal dust in any tight container such as a tin can, a glass jar or even a paper bag. To get uniform and complete seed coverage the container should not be more than half full of seed. Surplus dust may be removed by screening. Caution should be taken to avoid inhaling the dust.

Some seed of American origin is treated with New Improved Ceresan prior to sale. Caution should be exercised when applying dust protectants to seed which has been so treated, especially by the soak method. It has been established that some dust protectants such as Arasan, when used following treatment with New Improved Ceresan, cause severe injury to the seed.



Fig. 2. Soil sterilization by the box method. Note the large removable doors, lath separating flats, and gravity conveyor for the movement of the treated flats to the planting shed.

Soil Sterilization

Provided new soil is used and sanitary precautions are exercised, sterilization should not be necessary for the vast bulk of soil used to grow tomato *transplants*. It is desirable however, to sterilize all soil used for *seedling* production. Steam, fungicides, and fumigants are useful for this purpose.

Steam — For efficient sterilization by steam, soil should be held at a minimum temperature of 180°F. for 30 minutes. The physical condition and moisture content of the soil is important. Soil should be free of large lumps and should be moist as for transplanting. If the soil is too dry, complete penetration by steam is slow and often incomplete. If the soil is too moist, more heat is required and the additional moisture contributed during sterilization will tend to puddle it.

Weed seeds are destroyed by steam sterilization. Both beneficial and injurious micro-organisms are also destroyed by steam sterilization. If, therefore, sterilized soils are re-contaminated through careless handling or the use of contaminated tools, the development of disease may be more severe than in untreated soil. One precaution to avoid re-contamination is to sterilize shortly before seeding.

Many types of pits, bins and retorts are used for the sterilization of soil by steam. Any container is satisfactory which is capable of being closed or covered so that a minimum temperature of 180°F. may be maintained. The two most commonly used containers are the box and the inverted pan.

A type of box in which both soil and flats are sterilized at the same time is illustrated in Fig. 2. The box, which is sufficiently wide to hold flats placed lengthwise, is lined or covered with sheet metal. Large, closely fitting,

removable side doors facilitate the placing and removing of flats. Steam from the boiler enters the box at the bottom through perforated pipes. Wooden lath placed under the ends of each row of flats serve to separate them, thereby shortening the time interval required for steam to completely penetrate the soil. By placing the lath under the ends injury to flats is avoided, since the weight is borne by the solid portion. A box approximately 7 by 13 feet by 32 inches will accommodate about 115 flats. There are advantages in having two boxes of this size rather than one twice as large.

For the inverted pan method Berkeley and Richardson in Canada Department of Agriculture Publication 759 suggest the following:

"In this method, steam is passed into an inverted pan which is forced into the ground, and steam under pressure passed into it. The pan may be of any convenient size, though it is difficult to handle one larger than 70 square feet in area. Before passing in the steam, the pan should be weighted, so as to keep it in the ground and thus prevent the escape of steam around the edges."

Where soil is steam-sterilized in bulk, provision must be made for the disinfection of flats. By the bulk method more time is required for all of the soil to reach the necessary temperature.

Chemicals — Both fungicides and fumigants are used for soil disinfection. For many years formalin was the principal chemical used to free seedling compost from destructive fungi and bacteria. It is, however, unpleasant to use and one which most growers avoid if possible. While relatively new, Arasan and Naugatuck Thiram offer much promise as soil fungicides.

As to formalin, Howitt, Sands and Garrard in Ontario Department of Agriculture Bul. 386 discuss its use as follows:

"Formalin is a clear liquid. It is a 40% solution of formaldehyde gas in water. The soil should be dug up and in a very loose condition before adding the solution. Use 1 gal. of formalin to 40 gals. of water and by means of a sprinkling can apply this to the soil at the rate of 2 qts. per sq. ft. of soil. After treating cover the soil for a day or two to help keep the fumes in the soil. A tarpaulin may be used, or bags or papers that have been wet with the formalin solution. As soon as the soil is sufficiently dry, dig it up again to allow the fumes to escape. Do not set out any plants or sow any seeds for at least ten days after treating. Formalin should not be used where the fumes will reach other plants. Formalin, like many other chemical substances, will not control nematodes."

Arasan, being a fungicide, may be expected to control damping-off. Studies recently reported by C. D. McKeen, Canada Laboratory of Plant Pathology, Harrow, Ontario, will be of interest to growers who are not able to steam-sterilize soil for seedling production. When seed and soil were both treated with Arasan the control of damping-off in tomato seedlings was equal to that where the soil was sterilized with formalin. Soil treatment with Arasan, however, was reported to retard seedling emergence by a few hours. A mimeograph released by the Harrow Laboratory contains the following notes on rates and methods of applying Arasan in the soil:

1 ounce of Arasan will treat 9 cu. ft. of soil.

1 pound of Arasan will treat 144 cu. ft. of soil.

1 ounce of Arasan will treat 21 greenhouse flats (22" x 11" x 4") filled with soil to a depth of 3 inches.

There are approximately 25 to 26 *level teaspoonsfuls* in one ounce of Arasan.

The soil, when treated, should be relatively dry so that the chemical can be thoroughly mixed with the soil. Individual flats of soil may be treated (1 level teaspoonful to a flat of soil) or larger amounts of soil may be treated by mixing on the potting-house floor, etc.

NOTE: Do not use *more* Arasan than directions state.

Naugatuck Thiram is similar to Arasan and may be used alternatively. Since Naugatuck Thiram appears to be slightly stronger, McKeen recommends that it be used at the rate of $2\frac{3}{4}$ oz. per cu. yd. of soil. At this rate 1 oz. of Thiram would treat $8\frac{1}{4}$ cu. ft. of soil.

As to fumigants certain of the newer ones, such as Dowfume M C-2 and Larvacide, offer great promise for soil treatment. Like the fungicides these materials control disease-producing micro-organisms. Fumigants have an additional advantage, however, in that, to a great extent, they destroy weeds, weed seeds and insects such as wire worms.

For the application of the newer soil fumigants, equipment is now available which is highly suitable and relatively inexpensive. These devices are available where the chemicals are sold. Fumigants should always be used strictly in accordance with the manufacturers' directions. In general these may be indicated as follows:

Dowfume M C-2: For the control of disease use 4 lb. per 100 cu. ft. of compost or soil.

Larvacide: Average dosage for seed beds and flats is 15 to 18 lb. per 1000 sq. ft., or $\frac{3}{4}$ to 1 lb. per cu. ft. of soil.

Flash Flame — A new method of soil sterilization which involves pasteurization by flash flame is described by Newhall and Schroeder in *Farm Research** published by the New York State Agricultural Experiment Station, Geneva, N. Y. Soil is fed into the upper end of a revolving cylinder while heat from one or more blow torches is applied at the other end. The slope of the cylinder, which is adjustable, controls the speed with which the soil passes through. Soil for pasteurization should be screened and moist as for seed sowing. Fungi and most weed seeds are reported to have been satisfactorily controlled by a temperature of 170° to 180°F . Soil sufficient for 250 standard-size flats is stated to have been pasteurized in under three hours at an operating cost of less than one-half cent per flat for fuel. Mounted on wheels the pasteurizer is quite mobile.

Disinfection of Equipment

While it may not be either practicable or necessary to disinfect all equipment it is desirable to disinfect all flats and tools which come into contact with sterilized soil used for seedling production. Either steam or formalin may be used for this purpose. When formalin is used flats are immersed for 25 minutes in a solution consisting of one gal. of formalin to 25 gal. of water. Dry flats before using. Steam may be applied either in a bin or under pressure from a jet-equipped hose. If the jet method is employed all surfaces should be thoroughly sprayed.

Plant growers occasionally purchase flats and other facilities from growers who discontinue production. To avoid introducing disease it is desirable to sterilize all second-hand flats whether purchased or returned in error by contract growers.

Glass houses often harbour insects and diseases which are troublesome. While burning sulphur is not recommended for modern steel houses owing to its corrosive action on metal, the following suggestions by Berkeley and Richardson in Canada Department of Agriculture Publication 759, may be of interest to growers whose houses are constructed of wood:

* Volume 17, No. 1, January 1951

"In this connection it is a good practice to thoroughly fumigate the greenhouse just *previous to planting therein*, by burning sulphur, at the rate of 1 lb. per 1,000 cu. feet. Better results will be obtained if the sulphur is distributed evenly throughout the house in small piles, rather than in 1 or 2 larger piles. A satisfactory method of procedure is to kindle small fires in deep metal pans with wood or chips and pour on the sulphur after the blaze has started. Such fumigation will not only destroy insects, but will kill many destructive fungi as well. It should be pointed out that fumigation with sulphur is specially recommended for the prevention of the leaf-mould disease, but should not be burned in the greenhouse after the tomatoes have been planted".

To avoid the spread of disease in glass houses containing tomato plants it may be necessary, where insects are present, to fumigate or to spray. For the proper insecticide to use, consult the Ontario Protection Calendar for Vegetables Under Glass. It is available from your agricultural representative.

Application of Fungicides to Growing Plants

For efficient disease control it is recommended that fungicides be applied in spray form using a fine mist at a pressure of 300 to 450 pounds. Fungicidal dusts will give a measure of protection but are not considered as effective as sprays.

Spray seedlings when the first true leaves have fully developed. Repeat the application at 7- to 10-day intervals until the plants leave the nursery. Both the entire plant above the ground and the soil surface should receive a protective covering. To avoid injury, spray nozzles should be held at last four feet from the seedlings and plants. Even water applied under high pressure at close range can cause injury through physical impact.

The frequency of application will be influenced by the rate of growth and by precipitation, either natural or applied. Aim to keep a protective covering over all plant tissue. Rapid plant development produces new foliage which is not protected until it is thoroughly sprayed. Frequent rainfall and overhead applications of water serve to remove the protective covering which must be replaced. The last application should be made 3 or 4 days before field setting.

Fungicides suitable for spraying include Ziram, Basicop, Tricop (Tri-basic copper sulphate), C.O.C.S., and Cuprocid. For dusting, suitable fungicides include Basicop, C.O.C.S., and Trox.

Management

A skillful grower will not tolerate conditions which favour the development of disease. He will provide glass houses and sash which do not leak, he will provide sufficient pitch to his sash so that condensation and dripping are reduced to a minimum; he will avoid uncontrollable bottom heat; he will provide head room for his plants; and he will exercise discretion when watering and ventilating. Reference is made to these factors in the pages to follow.

PLANT-GROWING STRUCTURES AND EQUIPMENT

One of the important factors contributing to the cost of plant production is labour. While most growers recognize the importance of general layout to the amount of labour required for efficient operation, existing structures and space often place severe limitations upon changes which can be made. Some modification will, however, be necessary in the case of many growers if plant production is to be improved. Others are presently faced with the problem of replacements. Such growers should give serious consideration when planning their layout, to the part which mechanical aids may play in their operations. Scarcity and cost of good labour have forced mechanization upon most industries, and a greater degree of mechanization seems inevitable in the plant-growing industry. Attention will therefore be drawn to some aids, both structural and mechanical, which are already being used by tomato plant-growers who cater to the processing industry. If the emphasis seems to be placed upon tomato production in flats it is because this phase of the industry seems most in need of improved facilities.

Equipment employed by plant growers in Ontario varies in type, age and efficiency. Facilities range from modern structures which are primarily used for the production of specialty crops like cucumbers and tomatoes, to old, dilapidated structures which are neither sanitary nor otherwise suitable for the production of good plants.

Glass Houses

Some sort of glass house is necessary for starting tomato plants in Ontario. Glass houses, like all glass structures used for tomato-plant production, should be capable of good ventilation. Economy of construction is also an important consideration owing to the relatively short season during which these facilities are used by most plant growers.

Sash houses, with one or two tiers of standard sash on each side, are relatively economical and quite satisfactory. Individual sash may be opened or removed to permit entry, or for ventilation. The sash can also be readily removed for storing at the end of the season.

Tobacco houses are also economical of construction but are more difficult to ventilate. The butt-glass construction may, moreover, cause dripping of water onto the plants. Another disadvantage of this type of house is that plants situated at the side of the house are closer to the glass and dry out more readily thereby causing uneven plant development.

There is a tendency on the part of some growers to overload their glass houses in an effort to increase production. This is generally accomplished by suspending or supporting flats above the main bench. Under such circumstances both lots of plants suffer. The upper plants, being closer to the glass, require more frequent watering and develop too quickly and unevenly. Plants can be quite satisfactorily grown, finished, and adequately hardened in glass houses, provided these houses can be properly aerated, the glass is not too close to the plants, and the flats not in contact with soil, straw, or manure.

Owing to the ease and economy with which plants can be watered, and protected from frost, glass houses are being used increasingly for finishing plants where flat culture is employed.



Fig. 3. Ridge-and-furrow sash houses, each 15 feet wide, using a single row of standard sash on each side. Shadow from the ridge, which contains ventilators, moves during the day since the houses run north and south. Divided end-doors permit greater control of ventilation.



Fig. 4. Interior view of ridge-and-furrow houses illustrated in Fig. 3. Shadow indicates the picture was taken in the afternoon. Note that the flats are raised off the floor.



Fig. 5. Removable sides on single-unit houses permit greater aeration and facilitate the placing and removing of flats. Note placement of hot-water pipes.



Fig. 6. A device for protecting open sash against damage by wind. Sash is loosened by a turn of the crank.



Fig. 7. Beds protected by burlap-covered frames which rest on stakes. Straw in the paths is used to cover sides of beds. When additional protection is necessary the entire bed-area is covered with straw.



Fig. 8. Beds on the right are protected by cotton or burlap which is fastened at one side and drawn over when necessary. Beds at left will be protected by cotton and straw as in Fig. 9. Note burlap fence in upper left for protection from wind.

Steam and hot water provide the most efficient and the most uniform heat for glass houses. Sufficient boiler capacity should be provided to take care of any glass-covered beds used for finishing plants. Establishments where all of the plants are produced in one or two small houses can be heated with hot air, but hot water is preferred. Fumes from hot-air heating units can and frequently do, cause injury to tomato seedlings and plants.

Plant-growing structures should, if possible, run north and south so that sunlight will reach all sections at some time during the day. Plants growing on the south side of houses which run east and west will require more frequent watering.

Sash houses in which plants are finished should have sides $2\frac{1}{2}$ to 3 feet high, to provide ample space above the plants. An economical sash house is the ridge-and-furrow type illustrated in Figs. 3 and 4. Individual sash houses, while more costly, offer certain advantages. Glass-sided houses are not so desirable as those with frame sides. The glass sides are more costly to construct, and flats placed near the glass dry out more quickly and unevenly. Readily removable side doors as illustrated in Fig. 5 permit easy access for filling houses and greater aeration for hardening.

Finishing Beds

The latitude of south-western Ontario corresponds to that of northern California. This, together with the moderating influence of the Great Lakes, enables tomato plants to be finished in ground beds without glass covering. By contrast, plants in central and eastern Ontario must be protected by glass, and frequently by cotton and straw as well. The type of finishing bed required in these areas differs very greatly. For this reason they will be treated separately.

Ground Beds without Glass Covering — The so-called Leamington method of finishing plants is not characterized by fixed procedures. Rather it is constantly changing as new techniques and facilities are designed to improve the quality of plants.

Land is fitted in the fall and again in the spring prior to the establishment of the beds which are almost universally 6 by 48 feet in size. While there are several variations, beds are usually of two types. Some beds have board sides on which the burlap or cotton covering is rolled. Others have wooden stakes along the sides on which burlap covered frames are placed. Beds of the latter type are open at the sides and protected when necessary by straw. In the construction of board-sided beds 1- by 12-inch material in 12-foot lengths is employed using four boards supported by stakes on each side. Cross-members of 1- by 3-inch material spaced at intervals, and wires running the length of the bed, hold the burlap covering off the plants. The burlap is generally attached firmly to one side of the bed by nailed lath. These types are illustrated in Figs. 7 and 8.

Variations in the type of bed covering include the placing of cotton covered with straw directly upon the plants. When the covering is removed it is rolled back off the plants as illustrated in Fig. 9. Occasionally straw is spread directly over the plants and removed by a wooden rake when danger from frost has passed. This method involves more labour and is used only in an emergency by growers who lack other facilities.

Tents of various types which cover the entire area devoted to plant beds are employed by some growers. Ability to work beds in all types of weather,



Fig. 9. Cotton and straw covering rolled to one end of bed. Toughened plants are not injured either by placement or removal of the covering.



Fig. 10. Claims for this type of bed-covering include ability to work beds in all types of weather, and speed with which beds can be covered.

and speed with which beds can be covered, with a minimum of labour, are claimed as advantages for this type of covering. One type of tent is illustrated in Fig. 10.

Frost-guard equipment which relies upon infra-red rays for protection against frost is owned by some plant growers but has not as yet been employed for the protection of tomato plant beds in Ontario.

In most seasons auxiliary heat is not necessary to produce satisfactory plants for delivery on or before May 24. Occasionally, however, during cool backward seasons plant development is retarded and relatively few plants are ready prior to June 1. The use of steam or hot-water lines along one side of board-sided beds has proven worthwhile to ensure plant development and to guarantee plant delivery for any date after May 15. Auxiliary heat also simplifies the task of avoiding injury from the occasional frost which may be experienced.

Board or burlap fences which serve as windbreaks are recommended where plant beds are situated in exposed locations. Windbreaks not only protect the plant beds but provide more comfortable working conditions especially when plants are being transplanted.

Glass-Covered Beds — Glass-covered structures are essential for finishing tomato plants in central and eastern Ontario. If suitable glass houses are available so much the better. Most growers, however, rely upon sash-covered beds for finishing the bulk of their production.

The use of sash houses in place of sash beds offers many advantages. Construction costs per unit of production are not too much greater than properly constructed sash beds, yet plant capacity per unit of sash is considerably increased.

Beds should be sufficiently high or deep that plants do not touch the glass. It is, in fact, an advantage to have beds which are at least twice as high as plants are expected to grow. Double sash beds are preferred to single sash beds since a greater capacity per unit of sash is possible and a more uniform plant is generally produced. Beds, like glass houses, should always run north and south so that light will reach both sides of the bed at some time during the day. The pitch of the sash is important. The upper end of a standard six-foot sash should be at least 4½ inches higher than the lower end if condensation of moisture, and dripping are to be avoided.

Sash

Sash are usually of standard size 3 by 6 feet although larger sash, both custom and home made, are used. Sash of standard size are preferred since they are lighter, more easily handled and less likely to suffer breakage.

The use of sash with lapped glass reduces dripping and thereby eliminates one of the conditions favoring damping-off. So that maximum light may penetrate the sash, glass should be of standard size and should lap not more than three eighths of an inch.

The investment which many plant growers have in glass sash approaches, and often exceeds, that which they have in their glass houses. Sash should therefore be handled carefully and protected from wind damage. Following the plant season sash should be reconditioned, repainted if necessary, and stored carefully until required again. Any factor which contributes to the life and usefulness of equipment is important in reducing costs and overhead.

Many devices are employed to protect sash from wind damage. One method of holding sash open and secure when sash houses are ventilated is illustrated in Fig. 6. Sash on beds may be held in place by buttons, hooks, wire or lath. Where lath are used, sash are slid down rather than elevated for ventilation. In any event the upper end of the sash can be held in place by a slight overlap in ridge construction. During the growing season sash are often stacked at intervals when the beds are open. Lath tacked along both ends of the stack will serve to bind the pile and reduce damage in case of a sudden wind storm.

Flats

Both rectangular and square flats are used in Ontario. The former are employed province-wide. The latter are gaining popularity in eastern Ontario. While flat size varies, often from grower to grower, the standard flat is generally 24 by 11 by 3 inches. In south-western Ontario it is consistently 4 inches in depth. The square flat is generally 16 by 16 by 3 inches. Dimensions are outside measurements in each case. Material used for bottoms and sides is usually three-eighths of an inch in thickness, that for the ends three-quarters of an inch.

The breakage and loss of flats is considerable and represents an important item in the cost of plant production. Most plant growers regard the life of a flat as about four years. The depreciation on flats alone represents over ten percent of the gross returns for plants, based upon four years of service, flats valued at 30 cents each, and \$7.00 as the contract price for plants.

The material from which flats are made has an important relation to their period of usefulness. Cedar makes a longer-lasting flat than do other native woods. Cyprus is even better but is more costly. One plant grower in a neighbouring state uses cyprus and claims greater economy in the long run. Before assembly, new flats should always be treated with a suitable wood preservative. Copper preparations which will not affect the growth of plants, are available for impregnating wood. Copper preservatives impart a light green colour to the wood.

A suitable shelter should always be provided for storing flats during the off-season.

Another factor which contributes to the short life of flats is the practice of placing them in houses and beds directly upon heating manure, wet straw or soil. If flats are placed upon boards or runners the air space below will reduce wood-rotting and contribute toward the production of a superior plant.

It seems reasonable to expect that any factor which contributes to a reduction in the cost of producing plants would be reflected in the cost of plants to contract growers. These growers, by emptying, drying and returning flats immediately following field setting, can contribute greatly to their length of service. Horses and farm implements often cause severe damage to, or the destruction of, flats which have been left along fence lines and headlands. In fact the loss through breakage is considered by some growers to be equal to or greater than that through rotting.

Dibbles

Dibbles, which are round, pointed objects used to make holes for seedlings, and to firm the soil around the roots are of several types. They are generally made of wood although moulded aluminum dibbles are used by a few plant

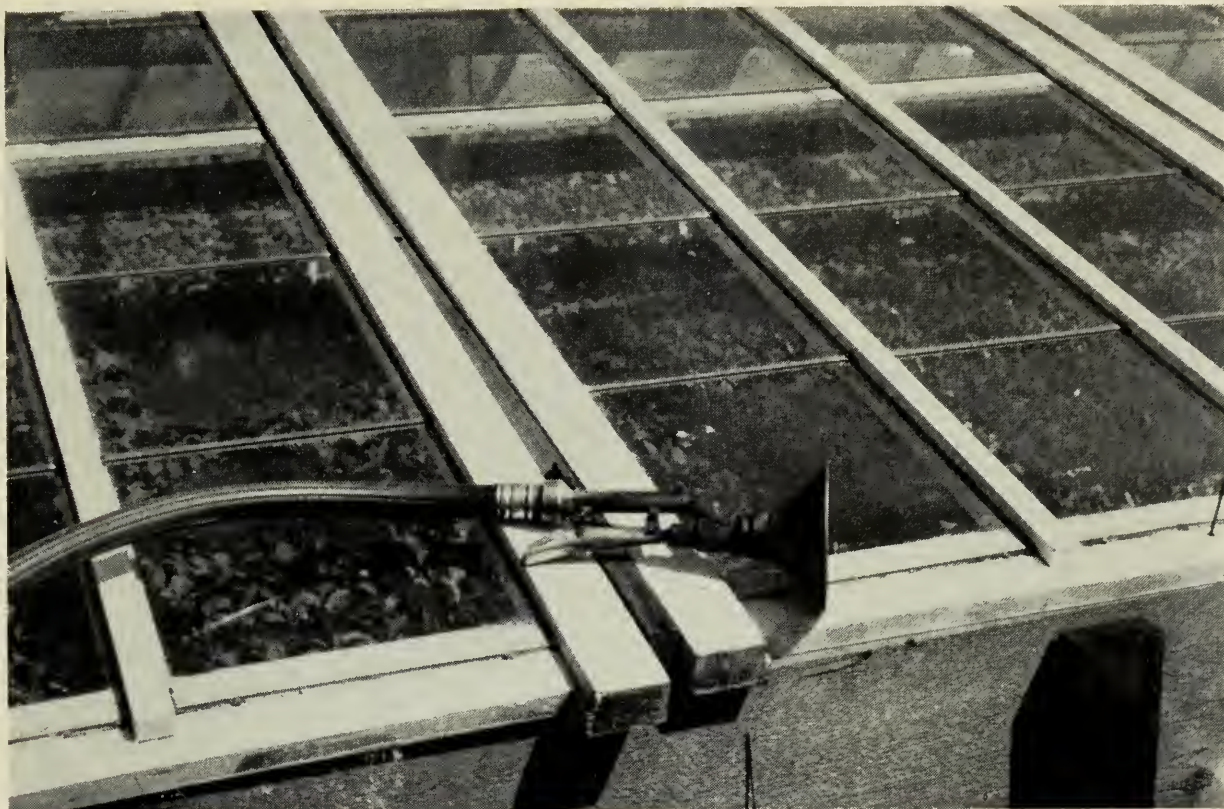


Fig. 11. Device for controlling both volume and placement of water when watering plants. Flow of water is controlled by finger-operated cut-off.

growers. Both types wear under constant use and must be replaced. Brass tips have been used on wooden dibbles to make them more wear-resistant but this serves to add to their weight and expense. Plastic dibbles have not been used in Ontario as yet but would seem to have a future. They are light in weight, resist wear, are economical, and soil does not adhere to them.

Marking Boards

Devices of many types are employed for marking flats. Marking boards with pegs corresponding to the location of plants in the flat are satisfactory and speedy of operation. Soil penetration is facilitated if marking boards are operated by a levering device. Marking boards consisting of a board with holes through which a dibble is punched, while simple and economical to construct, are slow and time-consuming to operate.

Watering Aids

It is essential to use a very fine spray for watering newly sown flats. It is also essential to be able to control both the volume and the placement of water when applied to seedlings and plants. A very useful type of control is illustrated in Fig. 11. By simply closing or opening the fingers, the flow of water through the rose can be cut off or released.

Soil Sterilizers

See discussion on soil sterilization commencing on page 17.



Fig. 12. Type of soil screen used by most growers in Ontario. Many growers use soil in sufficient volume to justify mechanization.



Fig. 13. Mechanically shaken three-quarter-inch mesh screen for conditioning soil. A coal elevator is used to drop the soil onto the screen.

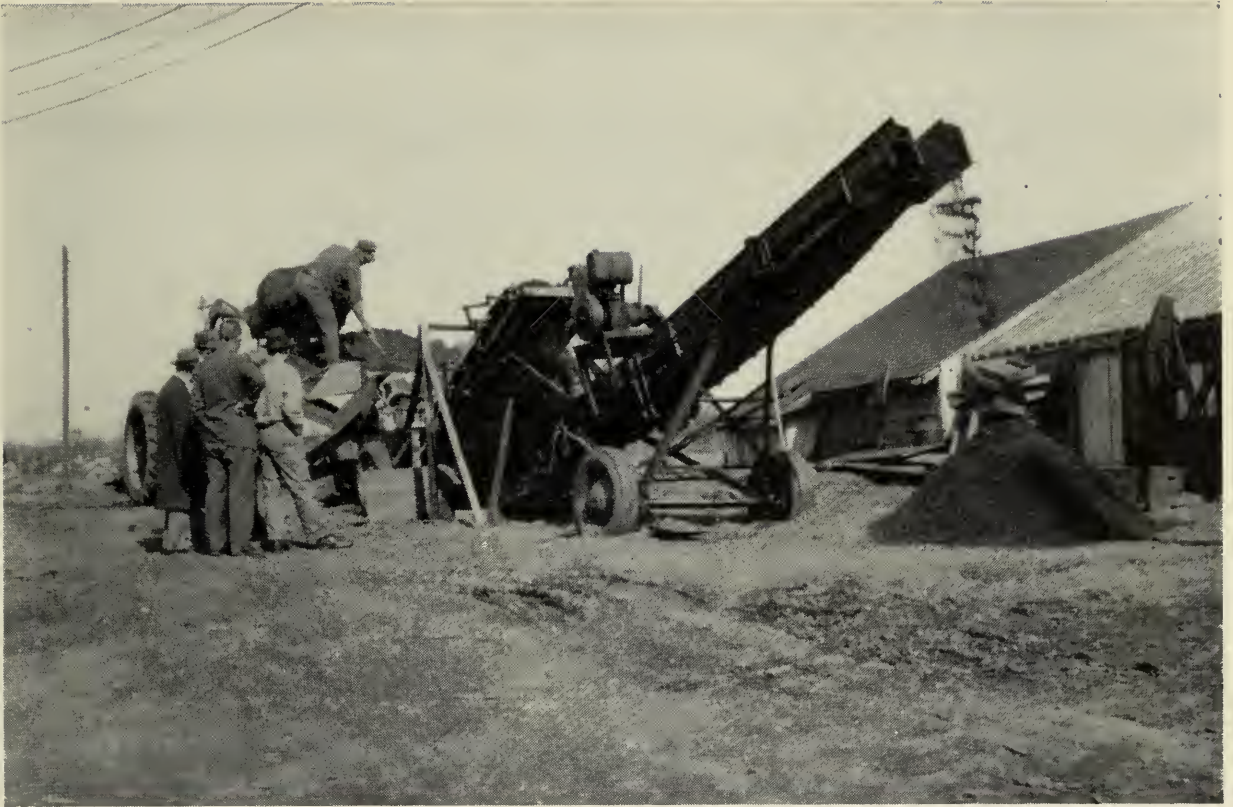


Fig. 14. Mechanized soil preparation. Tractor-mounted front-end shovel moves the soil to the platform where the fertilizer is added. The soil then passes through the grinder, up a coal elevator, through the screen, and is further mixed when dropped from larger coal elevator.

Soil Shredders

Some sort of soil shredder is necessary to prepare soil for plant production. The shredder may be home-made using spikes in a block of wood; it may be made from the cylinder of an old threshing machine; or it may be a machine specially made for the purpose. Since a soil shredder, properly used, contributes greatly to soil uniformity, no commercial plant grower can afford to be without one.

Soil Screens

A three-quarter-inch mesh screen made from heavy gauge wire is indispensable as a conditioner for soil, following grinding. Soil may be thrown by shovel against a screen set at a 45-degree angle, it may be passed through a power-driven rotary screen, or it may be dropped from a coal elevator on to a screen agitated by a cam shaft as illustrated in Fig. 13.

Soil Elevators

A coal elevator is a very worthwhile piece of equipment for plant growers who handle large quantities of soil. Not only does it eliminate an immense amount of hand labour when compost is being turned or shredded for use, but a high degree of uniformity is achieved when soil drops and builds up in a cone. Fig. 14 shows how two soil elevators, set up in combination with a soil shredder and wire screen, can reduce much of the labour associated with soil preparation.

Gravity Conveyors

This type of equipment is widely used in industry and warehouses for the movement of packaged goods. Its usefulness in moving flats of soil, and flats containing plants, from one part of the plant-growing establishment to another has not yet been fully realized by most growers. The interlocking sections are available in either steel or aluminum. Where the operation is large enough to justify the use of gravity conveyors in combination with a stevedore, an even greater economy in labour is possible.

Stevedores

A stevedore is simply a portable power-belt conveyor used alone or in combination with a gravity conveyor to elevate containers to any desired height. Where a sufficient difference in elevation is not available between points it may be necessary to create it.

Meteorological Aids

One or more accurate thermometers strategically placed in plant-growing structures will provide readings which serve as a guide to intelligent cultural practices. Another valuable instrument is the barometer. Growers who study barometric readings from day to day are seldom, if ever, caught unprepared by sudden changes in the weather.

Fore-warning as to danger of nightly frosts make it possible to prepare, in advance, for the emergency. Some growers are strategically located in proximity to airports or other meteorological stations from which valuable information can usually be obtained.

PRODUCTION PRACTICES

Two entirely different systems, the bed method and the tray method, are employed in Ontario for the production of tomato plants. In both instances the seed is sown and the seedlings are developed in flats. Where the bed method is used seedlings are transplanted into out-door beds. Where the tray method is used seedlings are transplanted into other flats or boxes for further development.

All plant-growing operations such as sowing and transplanting should be so timed that plants will grow slowly but continuously until the land is ready and plants are delivered to contract growers. Certain factors, however, complicate the application of accurate timing. While field setting frequently takes place as early as May 15 in more favoured areas, May 24 is generally regarded as the earliest sure date for field setting in Ontario. Seldom are all contract growers ready for plants before June 1, and seldom are all plants ready for contract growers before June 10. The weather influences not only the delivery date but the ability of many growers to set plants in the field on any given date. The lack of adequate facilities and labour to produce plants according to the optimum-time schedule is also a factor, more particularly where plants are finished in flats. The volume of plants produced by many growers demands that seed sowing commence earlier than is necessary or desirable, and be continued beyond the optimum date. As a consequence the development of some early seedlings and plants is retarded, if not unnecessarily checked, while plants transplanted after the optimum date are often forced along too fast.

Seedling Production

Tomato seedlings can be grown in hotbeds, greenhouse beds or benches, or in flats. Flat culture is employed almost universally in Ontario except in the case of growers who lack glass-house facilities.

Advantages attributed to flat culture include, greater control of seedling development; greater convenience and adaptability for mass production methods; more efficient utilization of glass-house space through the use of succession plantings; more favorable working conditions for labour; and fewer losses from frost and/or damping-off. Flat culture facilitates production under more sanitary conditions through the use of sterilized flats and sterilized soil.

Preparing Flats — New flats should be employed for seedling production unless old flats have been sterilized. The sterilization of soil in flats to be used for seedling production is a convenient and efficient way of treating both flats and soil simultaneously.

Seedlings do not remain in the flat more than three, or possibly four, weeks. Soil for seedling production need not, therefore, be so rich as for plant production. By cutting the regular compost soil with one-third coarse sand, drainage will be improved, conditions will be less favorable for damping off, and seedlings may be removed and separated for transplanting with less root destruction.

It is important to firm soil well in the corners of the flats so that the soil level will remain uniform after watering. Prior to sowing seed, soil should be levelled to a point about one-half inch below the top of the flat. A piece of sheet metal or an old license plate suitably cut is quite helpful. Soil is not necessary for the production of seedlings. Provided that the required nutrients are supplied, any growing medium which has a satisfactory physical condition is suitable. Vermiculite is ideal but is too expensive for general use. A coarse grade of washed sand is very satisfactory but requires more frequent watering than a soil medium.

Sowing Seed — Opinions differ as to the best date to sow seed. Some seedlings are unquestionably started too early. Many are started too late. There is evidence that, where flat culture is employed, an eight-week plant is superior to one grown more quickly or more slowly.

Good sturdy seedlings are essential for the production of sturdy plants. This type of seedling is not produced under crowded conditions. It is recommended, therefore, that not more than 750 seedlings should be produced in each standard-size flat. In general practice most growers aim to produce 1000 seedlings per flat. As many as 1500 and more have been observed in cases of a few growers. This is false economy since better seedlings are possible under less crowded conditions.

Seed may be sown broadcast, or in rows. Row culture is generally preferred because of the uniformity with which seedlings break ground. Seedlings grown in rows are more easily handled and suffer less root damage at time of transplanting owing to ease with which they may be lifted and separated.

Sowing seed in rows is regarded as too costly by some growers owing to the time involved. With a little organization and the use of planting aids the operation need not be costly. At one establishment in Ontario three workers sow 1000 flats, in rows, in a 10-hour day. The seed is sown by one person, while



Fig. 15. Planting devices, in combination with marking boards, can speed up seed sowing. This type can be made by the local tinsmith.

two helpers prepare the flats and cover the seed. Soil is ground and screened the previous day. Planting devices designed to sow seed in rows are available commercially. A very satisfactory one, extensively used in the Leamington area, can be made by the local tinsmith. See Fig. 15. Seed is shaken from a measuring can with holes in the lid. The metal planting-aid guides the seed into the bottom of trenches which have previously been made by a marking board.

Seed Covering — Soil for covering seed in flats should be free from stones and coarse material but should be open in texture. A good compost soil mixed with a coarse grade of sand, part for part, is satisfactory.

It is important that the seed covering be uniform in depth. When seed is sown in trenches made by a marking board it is necessary only to level the soil from the ridges, over the seed.

Stacking of flats — It is general practice with some growers, following seed sowing, to stack flats under benches or in piles. The top flats are generally covered with paper until the seedlings break ground. Little if any advantage is to be gained by stacking flats unless it be the greater utilization of glass-house space where a second planting is started before the previous planting is moved to cooling beds. Economy in labour, owing to less frequent watering, is also claimed. In practice, the stacking of flats presents certain disadvantages. The soil at one or both sides of the flats usually dries out thereby contributing to uneven seedling emergence. Flats generally dry out on the side adjacent to heating units or on the side exposed to the sun's rays. Unless stacked flats are spread out immediately the seedlings break soil, the seedlings eventually will be elongated, crooked, and spindly. No amount of after-care will overcome this poor start. Where glass-house space permits it is considered better practice to avoid stacking flats.

Handling — A temperature of 70°F. or better should be maintained until the first true leaves start to develop. If, because of a second planting of seedlings or for other reasons, the temperature cannot then be reduced it is desirable to move the seedling flats to cooling beds. This will tend to slow up the development of top growth and result in short sturdy seedlings with strong root systems. It is possible, even in glass houses, by control of heat and curtailment of moisture, to produce well-grown seedlings with firm, slightly purpled, stems. It is not desirable to excessively harden the seedlings, however, since plant growth is thereby unnecessarily checked.

Weed Development — Weeds do not present a problem in properly prepared compost. Soil sterilization by steam gives effective control of weeds as well as soil-borne diseases.

Transplanting

Tomato plants, when transplanted, suffer a distinct shock owing to the destruction of young feeder roots. The shock is lessened if well-grown seedlings are transplanted at a relatively early stage.

Weak or diseased seedlings should, on no account, be transplanted since they rarely if ever develop into merchantable plants. The better the seedlings, the less sorting will be required and the greater will be the daily production per worker. Success or failure in plant production is often influenced by the quality of the seedlings and the care with which they are transplanted.

Bed Culture — Seedlings used for transplanting into beds are larger than those used for flat culture. They are set 1½ inches apart in rows spaced at 3-inch intervals. Beds are usually of standard size. Each 8- by 48-foot bed accommodates 12,288 plants but production is estimated on the basis of 12,000 plants per bed. A more bushy plant with a heavier stem is produced where seedlings are spaced 2 inches apart in rows spaced at 4 inches. Spaced 2 by 4 inches, each standard-size bed would accommodate 9,216 plants.

Rotary tillage implements are replacing the single-horse cultivator to loosen compacted soil in beds being fitted to receive transplants.

It is desirable to thoroughly wet seedling flats some time prior to transplanting. Seedlings lift more readily and seem better able to withstand the shock of transplanting. Root damage will be further reduced by striking one end of the flat on the ground to loosen the soil. Seedlings first removed from the flat are those at the end remote from that which received the impact.

Transplanting is usually done on a piecework basis by girls who work two to a bed. Both girls start at the same end and progress at a uniform rate toward the other end. Guided by marking boards checked at 3-inch intervals, trenches are opened by a 30-inch piece of heavy sheet steel, one side of which has been rolled to form a handle. Starter solution is applied in the trench and plants are set about 3 inches deep. Soil is then moved by hand against the seedling roots and firmed by a steel trenching tool when the next row is opened. During inclement weather beds are covered with cotton or jute as planting progresses.

Seedlings are usually transplanted into ground beds during the last week of April and are ready for delivery in about 3 to 3½ weeks. Occasionally, owing to inclement weather, transplanting is delayed for a few days. Delivery date is influenced by date seedlings are set in the bed, by subsequent weather, and by growers' ability and willingness to provide, when necessary, supplementary heat and or nutrients.



Fig. 16. An off-season shelter for flats is a good investment.

Flat culture — The proper stage to transplant seedlings into flats is when the first true leaves have developed. Flats are filled with soil and levelled as for seed sowing.

Most plant growers aim to produce 100 marketable plants per flat by setting 8 rows of 13 seedlings each. Better plants can be produced under less crowded conditions. Some processors and growers contract for plants on the basis of 85 per standard flat grown in 8 rows of 11 plants each.

Transplanting is done mainly by female workers. Much of the work is done on a piecework basis but many growers have found that more thorough work is accomplished when girls work on the hourly basis. A radio in the transplanting room serves to stimulate production by curtailing conversation and clowning.

Where marking boards are used seedlings are spotted into holes and soil is firmed against the roots, sometimes by thumb and forefinger but more generally by a dibble. Where marking boards are not employed workers, using a dibble, spot the required number of plants along one side and along one end of the flat, and then proceed to fill up each row. The placement of plants is not usually as uniform as where marking boards are used. Care should be exercised to eliminate air pockets by firming the soil against the roots of the seedlings. Choking plants by pressing soil too firmly against tender seedlings *at ground level* is a common source of trouble where transplanting is done by inexperienced help and where payment on a piecework basis encourages too much haste.

Plants are sometimes placed in trenches opened in the flat with a wedge-shaped trenching tool. Growers who use this method claim that workers cannot choke seedlings, since soil is firmed against the roots of one row of

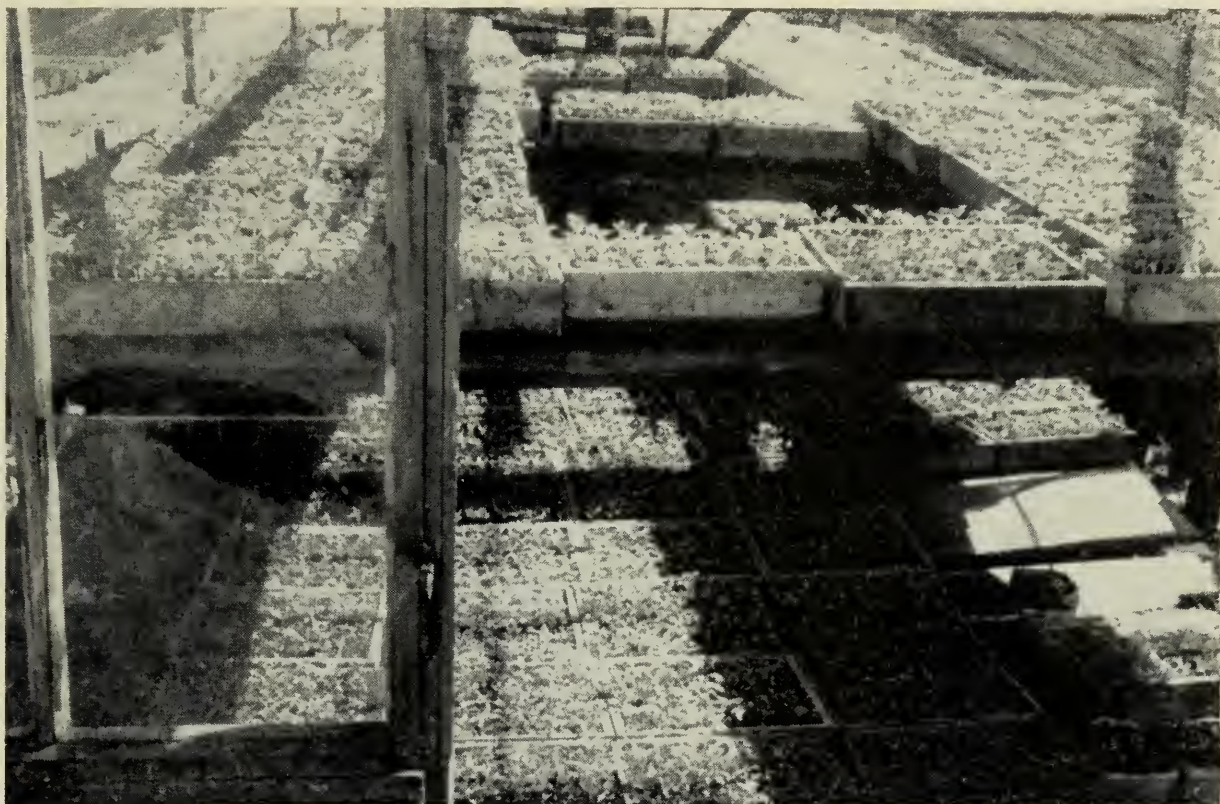


Fig. 17. An extreme case of overloading glass-house facilities. Proximity to glass, dripping of water, and shade result in uneven plant development, and often in the development of disease.

seedlings as the next furrow is opened. Crowding of the rows to one side of the flat often results where this method is used.

Growing

The experience and skill of a plant grower may usually be measured by his ability to keep plants growing slowly, continuously and uniformly, until suitably hardened, good plants, are delivered on the date specified. Good seedlings, properly transplanted into a suitable growing medium, should be capable of development into good plants. A plant grower's skill, however, finds expression in operations such as watering, ventilating, the application of supplementary heat and, when required nutrients.

Application of Water — Watering is very important, particularly in the initial stages of plant development. A skillful plant grower learns to anticipate and to recognize the need for water and to apply it only to those portions of a bed, or even of a flat, which require it. So important is this operation that many plant growers refuse to detail the responsibility of watering, in the initial stages, even to their most trusted and experienced help.

As a precaution against the development of disease, watering should preferably be done in the morning. In any event it is not wise to water plants later than mid-afternoon. Applications of water serve to induce growth and can, under uncontrolled conditions, result in excessive plant elongation. Withholding water slows up plant development and induces hardening.

Ventilation — Moisture in the form of vapour is constantly being given off by living tomato plants. Most of the moisture taken up by the roots is, in fact, given off by the foliage as vapour. The quantity of water so transpired will depend upon the supply of water available to the roots, the extent of the



Fig. 18. Where sash are provided with insufficient pitch, condensation of moisture on the glass and dripping of water on the plants usually result.



Fig. 19. This type of house, heated exclusively by the sun's rays and by a heavy layer of manure under the flats, has its disadvantages.

root system, and the area of leaf surface through which moisture escapes. When plant-growing structures are not, or cannot, be properly ventilated, this water vapour condenses on the underside of the glass and drips onto the plants. Most fungous diseases thrive under conditions of high humidity and moisture. Proper ventilation serves to remove excess humidity from the plant environment and thereby to discourage disease development. Ventilation also serves to lower air temperature, especially in glass-covered structures, thereby slowing up plant development.

When ventilating, care should be exercised to prevent drafts from injuring tender plants. When ventilating glass structures on cold windy days, open vents or sash on the leeward side. Cloth-covered beds may require supplementary covering.

Careful ventilation, coupled with discreet watering, contributes to the production of healthy, sturdy plants with firm, slightly purpled, stems. Indiscreet watering or ventilation is likely to result in the loss of plants by disease, or in the production of plants which are diseased, leggy and soft.

Supplementary Heat — The application of supplementary heat is a necessity in areas where plants are finished in flats. On the manner of application, however, there is less agreement among growers. Currently, most plant growers rely upon bottom heat generated by horse manure, and upon glass sash, to provide protection from frost in finishing beds. In some instances entire greenhouses, of the tobacco type, are heated exclusively by a thick layer of horse manure on the floor. Where plants are grown on specialized truck-crop farms in areas such as around Burlington, growers take advantage of hot beds which have already produced one or more crops of early spring vegetables. More generally, however, hot beds or cooling beds with bottom heat are prepared especially for tomato plants.

Hot water or steam for heating beds and other structures used for finishing plants, offer many advantages over the horse-manure method. The disadvantages of manure as a source of heat include:

- (1) Heat cannot be controlled as required by weather and plant development.
- (2) Plant growth cannot be controlled once plant roots have penetrated into the manure.
- (3) Heating manure rots flats and beds.

Some growers in the Leamington area have provided for the application of supplementary heat, when necessary, in their ground finishing beds. A hot-water line, in beds covered only by jute, may speed-up plant development in cool backward weather and make possible the delivery of plants on schedule. This practice might profitably be adopted by other growers.

Supplementary Nutrients — The appearance of tomato plants is not always a reliable guide to problems associated with nutrition. Neither should soil testing be regarded as infallible. Soil testing is, rather, considered as a necessary preliminary to intelligent feeding based upon experience, plant response, weather conditions and cultural practices.

Plants do not absorb nutrients readily during cool, dull weather. Lack of growth, coupled with a yellowing of plant foliage, may indicate a deficiency of nutrients or it may point to an excess of soluble salts. If the latter, an application of fertilizer will aggravate the situation. Plant beds subjected



Fig. 20. Small glass house which is heated by hot air. This type of house, like that illustrated in Fig. 19 is more difficult to ventilate than most sash houses.



Fig. 21. Greater use of plant-growing facilities is possible where tomato plants follow one or more crops of early spring vegetables as in this efficient plant-growing establishment. Note the board fence for protection from wind.

to prolonged periods of rainfall prior to or shortly after plants are set, may have much of the nitrates, and possibly the potash, leached away. Under such circumstances a nitrogen and possibly a potash deficiency would be indicated. Where plants, growing under glass in soil which presumably carried sufficient nutrients, do not thrive, a test for soluble salts and possibly a soil analysis may be called for. Under conditions of high soluble salts unthriftiness is usually accompanied by a yellowing of the foliage, and in extreme cases by a purpling and hardening of the stems and leaves.

While individual situations may call for more specific treatment the following generalizations may be of interest. Excess soluble salts may be leached from the environment of plant roots by an application of 2 to 3 gallons of water per square foot. If practicable, soil should also be loosened by stirring or cultivation to permit greater aeration.

Supplementary nutrients may be applied in either solid or liquid form. In either case, to avoid injury, it is desirable to spray immediately thereafter with water to remove traces of fertilizer from the foliage.

Phosphoric acid is not readily available to the plant. It must, therefore, be applied several months in advance of use of the soil so that it will be available when needed. In cases where an emergency situation has developed owing to phosphorus deficiency, mono-calcium phosphate applied at the rate of 1 lb. to 100 sq. ft. can be used to pull the crop out of difficulty. This material is expensive but the phosphorus is readily available.

The following rates of application are considered safe where supplementary applications of nitrogen and/or potash are called for:

Nitrogen — 1 oz. nitrate of soda per 2 gal. water
or — 1 oz. ammonium nitrate per 7 gal. water
or — $\frac{1}{2}$ lb. ammonium nitrate per 100 sq. ft. when applied in the dry form.

Potash — 1 oz. muriate or sulphate of potash per 2 gal. water
or — 1 lb. muriate or sulphate of potash per cu. yd. of soil.

Where a complete fertilizer is used a 1:2:1 ratio is preferred. It may be desirable to use a higher potash ratio in the case of light soils. Completely soluble fertilizers are available and are very useful where a complete fertilizer is required.

Pruning — For convenience in field setting and for quick recovery, plants should be 6 to 10 inches in height and developing side shoots. The height of plants at time of field setting is often influenced by weather conditions during the few days previous to delivery or setting. A series of warm rains may delay field operations and may, if accompanied by high temperatures, contribute to an elongation of plants even to the extent of several inches in a twenty-four hour period.

To offset this elongation and to encourage the development of side shoots, plants are sometimes pruned. The type of pruning varies, as does its application, from the raking of bed-grown plants to the use of a corn hook for the decapitation of flat-grown plants. The raking of plant beds as practised in the Leamington area serves also to develop a more uniform growth in beds which may exhibit a lack of uniformity.

In the raking of plant beds a square-toothed garden rake is used. Holding the rake as one would a scythe the operator stands at one side of the bed and with three sharp upward strokes, rakes the plants on the half of the bed

adjacent to him. The operation proceeds the length of the bed and then back along the other side. Growing tips of plants are not impaired but a substantial portion of the foliage is removed from the plant. Following raking, the beds present a ragged, if not a tragic appearance, and paths between the beds are littered with tomato foliage. About three days later plant beds seem to have recovered and upward growth has been arrested. On closer examination it will be noted that most of the leaflets on the primary leaves have been removed, branching has developed in the axils of these leaves, and the uninjured growing points have developed some new growth. The raking of plant beds in the Leamington area is general practice, and contract growers seem to prefer plants which have been so treated.

The pruning of plants grown in flats is not practised commercially in Ontario. Tall, leggy plants are, of course, objectionable. So also is the possibility of spreading virus disease, a very real danger.

The necessity for pruning flat-grown plants, with its attendant risk of spreading disease, may be reduced if not removed, by the use of efficient equipment and skillful management. The use of beds with sufficient head room, the substitution of hot water or steam for manure as a source of heat, the raising of flats so that plant-root development will be confined to the soil in the flats, and the curtailment of water, will go far toward overcoming the development of tall, leggy plants.

Hardening — The toughening of tomato plants prior to field setting is referred to as hardening. During the hardening process tomato plants undergo certain changes, some of which are readily apparent. Growth processes are slowed up, plant tissues become firm or hard, and purple pigments develop, first on the stems and later on the leaves. The degree to which these characteristics develop will depend upon the severity of the hardening process. Hardening may be induced by exposure to sub-optimum temperature and by withholding moisture. Carbohydrates, which would normally have been utilized in the formation of new tissue, are stored within the plant. This reserve is drawn upon by the plant for the development of a new root system.

Tomato plants are frequently subjected to low temperatures after field setting. It is usually considered that the purpose of hardening is to enable plants to survive these low temperatures. Actually the lowered moisture content assists plant tissue to withstand any adversity including low temperatures, high temperatures, cold chilling winds, hot dessicating winds, drought, and bright sunshine.

Excessive hardening, which is recognized by a distinct stunting of the plant coupled with an excessive development of blue pigment in the foliage, is not desirable. Plants so treated are slow to recover when set in the field. The more severe the hardening the slower is the recovery and the smaller will be the crop prospect. Plants which are not sufficiently toughened are equally objectionable. They are usually soft, spindly, and more likely to suffer loss especially when transplanted under adverse conditions. Good plants are grown slowly but continuously.

Delivery

Only good plants, suitably hardened, should be permitted to leave the nursery, and plants should be field set as soon as possible thereafter. This fact is recognized by growers and users of pulled plants but it applies also to plants finished in flats. Plants should be sprayed with a recommended fungicide

3 to 4 days prior to release. Spraying should not be done later than 48 hours before plants are to be transplanted.

Pulled plants — Plants finished in ground beds are always pulled for delivery to contract growers. Flat-grown plants are sometimes pulled for delivery to more distant points. Generally speaking, however, unless they are exceptionally well grown, the pulling of flat-grown plants for other than local and immediate setting presents many difficulties.

Beds from which plants are to be pulled should be thoroughly watered the night before. Root damage will be lessened if plants are loosened by means of a fork just prior to pulling. A five-tined manure fork is satisfactory for the purpose.

Plants are pulled usually by female workers who assemble them in bunches of fifty. To avoid lack of uniformity in size of plants, within bundles and between bundles in any given lot, strict supervision is necessary especially where the operation is done on a piecework basis. Spot pulling is sometimes necessary owing to lack of uniformity in size of plants. Undersized plants usually are ready for pulling a day or two later.

Contract growers in south-western Ontario advise their processors when they are ready for plants. The processor in turn advises the plant growers that a certain contract grower will call at a specified time for a stipulated number of plants. Plants are pulled only as required and are always fresh from the bed. Usually only sufficient plants for the day's needs are taken at one time. Since as many as 9,000 plants, in bundles of 50 plants each, can readily be packed into the trunk compartment of the family car, the economy and convenience of this method of delivery is apparent.

For delivery by transport to points in central and eastern Ontario pulled plants are usually packed in five-eighths bushel hampers. A nest of straw placed in the bottom of each hamper protects the roots and keeps them moist. Depending upon plant size hampers usually hold about 8 bundles of 50 plants each. Plants for shipment should not be wrapped too completely in paper. Usually a paper band is wrapped around the stems leaving roots and most of the foliage unwrapped. Excessive wrapping and crowding of too many bundles into hampers induces heating and possibly the development of disease. Immersing hampers two-thirds into water prior to loading contributes to the arrival of plants in a fresher condition at destination. For long hauls during hot weather refrigerated transports may be necessary.

Plants in flats — When necessary to hold plants back this can be done much better by a skillful plant grower than by a contract tomato grower. The latter usually lacks both time and equipment for their care. Plant growers quite understandably wish to be relieved of their plants as soon as they are ready, especially when that date occurs after May 24. Too often, however, flat-grown plants are delivered to contract growers at the convenience of the trucker and even on the insistence of contract growers themselves, long before the land is ready to receive them. Many of these plants are left unattended and uncared for in yards, along fence lines or road allowances. Such plants usually become so hardened through exposure and drought that many days or even weeks are required for them to recover and commence to grow.

Justly or unjustly, most plant growers are judged by the performance of their plants in the field. Anything which can be done to encourage field setting as soon as possible after delivery, would therefore seem to be worthwhile.

CONCLUSION

In the foregoing pages an effort has been made to direct attention to certain factors which are considered important in the production and delivery of good tomato plants for the processing industry. Also, attention has been directed to shortcomings of some of the practices presently in use.

Growers of tomato plants must always be mindful of their responsibility to deliver good plants which are free from disease. They must also keep in mind that their very existence as growers of tomato plants for the processing industry is now being challenged by the importation of plants from the south. It is hoped that this bulletin may, in some measure, assist them to meet this challenge by the production and delivery of superior plants.

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MICROBES ON THE FARM

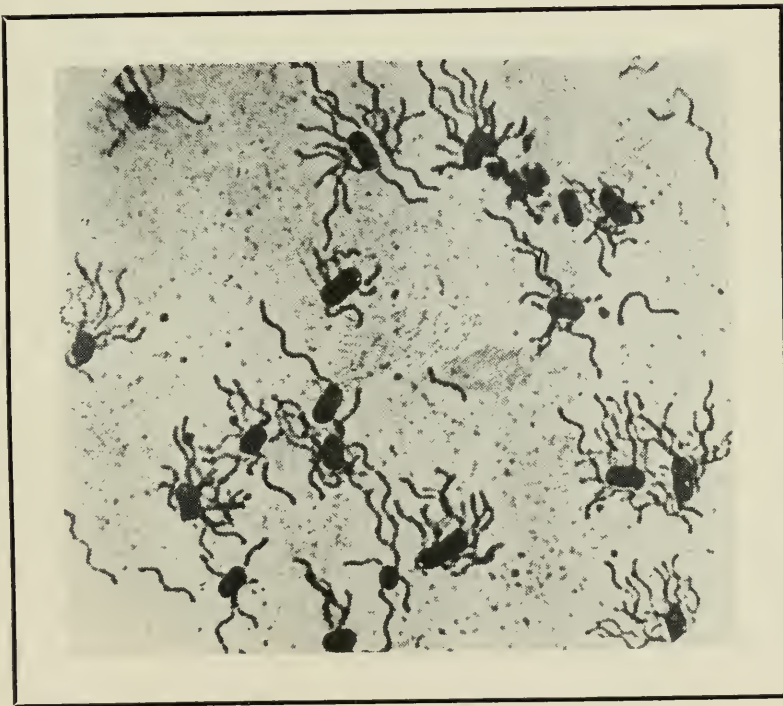
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MICROBES ON THE FARM

INTRODUCTION

IT IS NOT generally realized that farmers and other people living in rural areas are confronted with bacteriological problems not encountered by people in urban centres. Many requests constantly are received by this department for information on sewage disposal, water supplies, silage and other problems. Texts on agricultural bacteriology are few, usually expensive and not always suitable. Since the printing of the widely read bulletin No. 265, entitled: "Bacteria—Friends and Foes" (1921) by Professor D. H. Jones was discontinued, there have been no bulletins of a general nature available for distribution.

It is hoped that the information compiled in this bulletin will be of assistance to farmers, gardeners and country dwellers in general. Certain sections contained in Bulletin No. 265, such as human and animal diseases, detailed canning methods etc., have not been included, because, since that bulletin was printed, bulletins and texts are available on these individual subjects. On the other hand, certain additions have been made in answer to numerous requests from time to time.

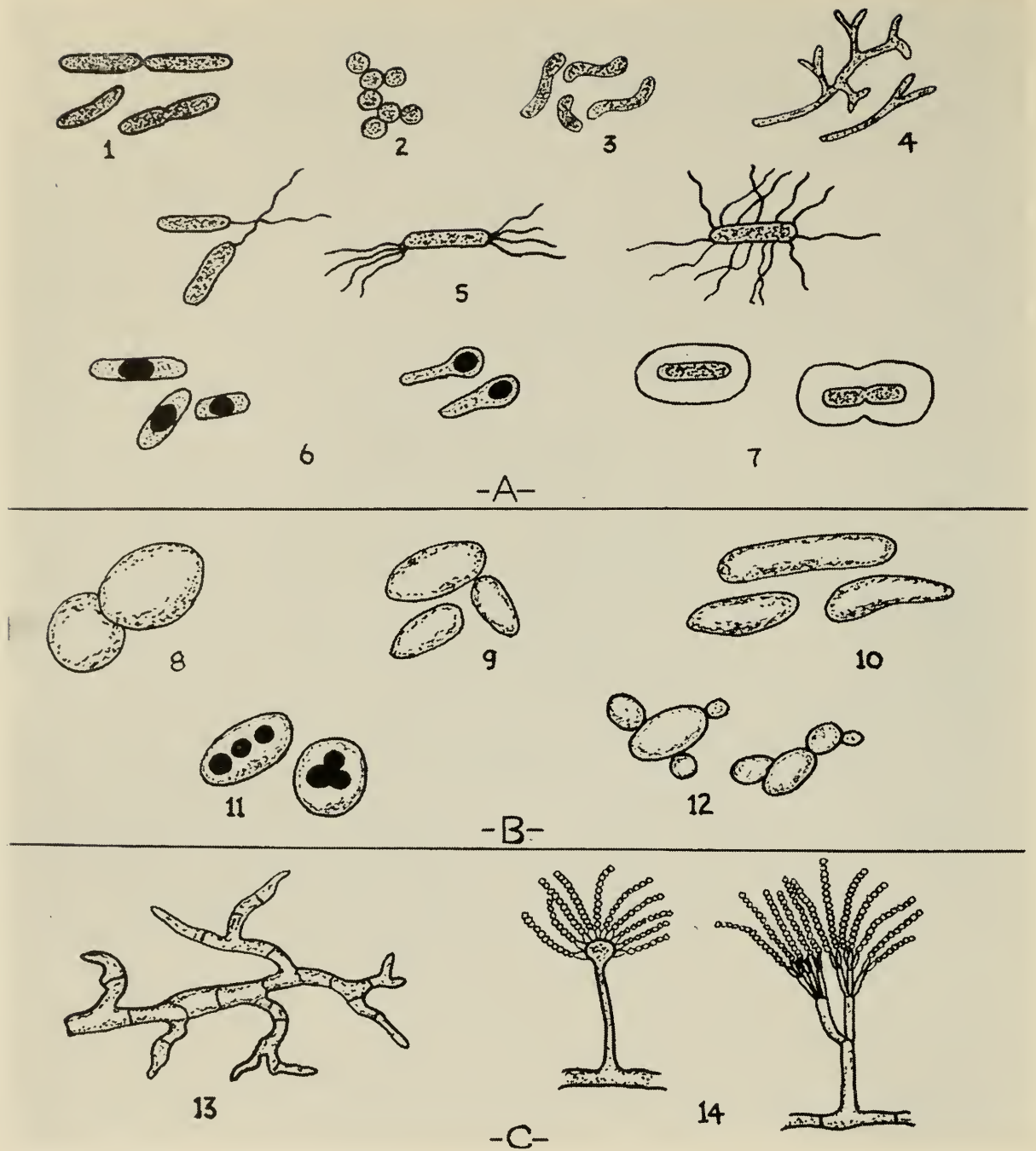


Fig. 1. Bacteria, Yeasts and Moulds. (A) Bacteria: (1) rods, (2) spheres, (3) spirals, (4) thread bacteria, (5) organs of locomotion, (6) spore formation, (7) capsules.

(B) Yeasts: (8), (9) and (10) different shapes of yeasts, (11) spore formation, (12) budding.

(C) Moulds: (13) mould thread or mycelium, (14) formation of mould spores. (E.H.G.)

BACTERIA, YEASTS AND MOULDS

BACTERIOLOGY is the science which deals with the study of microscopical forms of plant life known as bacteria. Other microscopical forms of life, such as yeasts and moulds, also are studied. While bacteria are regarded to be the most important, yeasts and moulds play active roles in various phases of agriculture and industry. To better understand the activities of these micro-organisms, a knowledge of their nature, shape and other characteristics is necessary.

DESCRIPTION

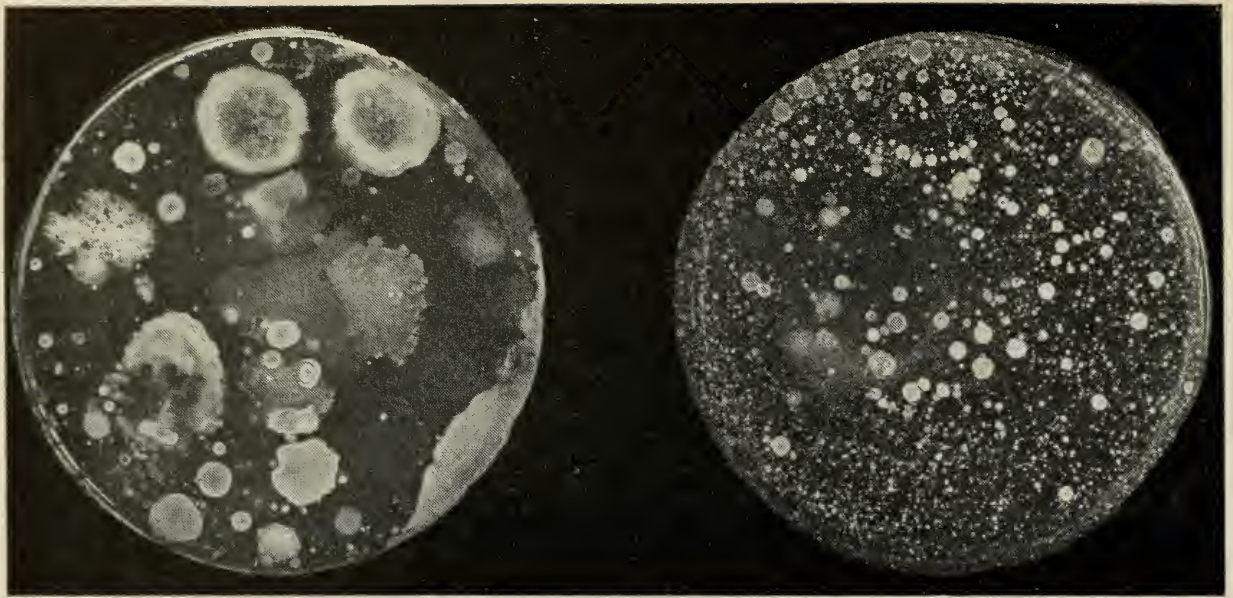
Bacteria — Sometimes termed microbes, germs, or organisms, bacteria are one-celled plants, each consisting of a minute speck of jelly-like substance surrounded by a membrane. Bacteria are too small to be seen with the naked eye and are studied under a microscope. They may be of several shapes, namely, spheres, rods, spirals and threads. They rapidly multiply by each cell splitting into two daughter cells every 20–30 minutes, resulting in millions of bacteria in a few hours. Some species can move in liquids by a wriggling, snake-like motion while others are propelled by hair-like appendages attached to the ends or sides of the cell. Certain bacteria can form a single resting spore in each cell; this spore is very resistant to heat, dryness and disinfectants. Warmth and moisture are required to germinate the spore which may remain alive but dormant for many years. Certain species of bacteria are able to form gummy capsules around themselves, causing the cells to cling together in slimy or stringy strands.

Yeasts — Also one-celled plants, yeasts are microscopical in size but larger than bacteria. They usually are spherical or oval in shape, but a few species are rod-shaped. They have no powers of movement. Some types form a number of resting spores in each cell. Yeasts reproduce their own kind principally by budding, whereby daughter cells are formed on the outside of the cell.

Moulds — Microscopical, thread-like plants, forming various colored, fluffy masses or colonies that can be seen with the naked eye. Moulds may be one or many-celled and they reproduce mainly by forming spores on specialized stalks; some species form special resting bodies. Moulds more closely resemble true plants than do bacteria and yeasts.

DISTRIBUTION AND SPREAD

With the possible exception of great altitudes, extreme depths of the earth and in the healthy tissues of man, animals and plants, micro-organisms are found everywhere. Bacteria are found in countless numbers in the soil and also are plentiful in ponds, lakes, pools and other bodies of water. They are present on the hands, face and other body surfaces of man, as well as in body discharges. Millions of bacteria and moulds are found in decaying materials and many are found in the atmosphere, especially in barns, stables, poultry houses, etc. Moulds are most common in the soil, on dust and on decaying materials. Yeasts are not so widely distributed but are plentiful on fruits, leaves and in the soil under trees, vines and flowers.



**Fig. 2. Numerous colonies of bacteria obtained from two soil samples.
(Each colony contains great numbers of bacteria.) (D.H.J.)**

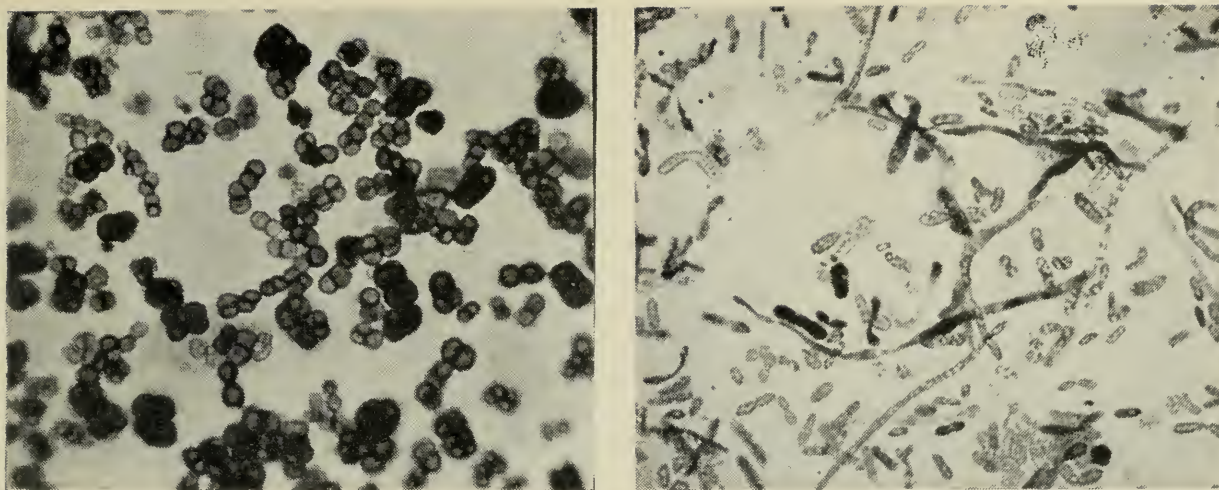
Bacteria, moulds and yeasts are spread from place to place in various ways. Man and his equipment are responsible for the spread of great numbers of them while insects carry many types for varying distances. Streams, ditches and other moving bodies of water carry soil and disease types. They are carried by birds and animals, and many are seed borne. Micro-organisms are transported from place to place on the surface of fruits, vegetables and other foods. They are blown by the wind on dust and organic matter, and rains and fogs assist in their dissemination.

IMPORTANCE

Bacteria generally are thought of in terms of disease and while certain types cause disease of man, animals and plants, the majority of them are beneficial rather than harmful. Bacteria and moulds in the soil are responsible for the decay of organic matter and sewage. Without certain types it would be impossible to manufacture certain foods and dairy products. Bacteria also are responsible for important industrial fermentations. While moulds cause certain diseases and are one of the chief agents of fruit and vegetable spoilage, they are responsible for certain fermentations and are becoming increasingly important as the source of antibiotics, such as penicillin. Yeasts play little part in soil decomposition and cause few diseases, but are the chief agents of fermentations, being responsible for the manufacture of bread and alcohol.

SOIL BACTERIOLOGY

Fertile soils contain countless numbers of bacteria as well as other forms of microscopical life. Soil micro-organisms are mainly beneficial, and plants, animals and humans depend upon their activities. The majority of them are found more or less near the surface of the soil and the numbers decrease as the depth increases. A well cultivated soil may contain many millions per ounce in the top 6 or 8 inches, while in other soils there may be few or none at 2-3 feet



**Fig. 3. Spherical and rod types of nitrogen-fixing *Azotobacter*.
Magnified 1,000 times. (D.H.J.)**

depths. The soil is an excellent medium for the growth of micro-organisms, and their numbers, types and activities depend upon the amount of oxygen, nature of soil, moisture and other factors.

DECOMPOSITION

The function of soil organisms is to decompose plant, animal and mineral materials into simple substances available for plant growth. Such a process is known as decay, and without such action there would be little or no plant growth, therefore man depends upon soil micro-organisms for his food supply. Certain groups of bacteria are responsible for decomposing certain substances, thus nitrogenous materials are broken down to available nitrates in successive steps, each group of bacteria playing an important part. The same is true of the decomposition of other substances to carbonates, sulphates, phosphates, etc. Certain minerals also are acted upon by soil bacteria, thus insoluble compounds of phosphorous are changed into soluble forms, and iron compounds are formed by the iron bacteria.

NITROGEN FIXATION

Azotobacter — Many soils are deficient in nitrogen, therefore its addition to soils is extremely important. Certain groups of bacteria are responsible for the accumulation of nitrogen in the soil by a process known as “nitrogen fixation” whereby the bacteria assimilate atmospheric nitrogen and add it to the soil in a form that plants can use. One of these groups is known as *Azotobacter* and these bacteria are fairly abundant in fertile sandy soils; they are few or absent in acid soils. They require a neutral or alkaline soil and plenty of organic matter from which they may obtain food and energy for their growth and multiplication. They are not associated with the roots of legume crops and are free in the soil. While the amount of nitrogen fixed per acre is not large, *Azotobacter* definitely play an important part in the accumulation of nitrogen in the soil.

Legume Bacteria — It has been known since early Roman times that legumes enrich the soil with nitrogen, but only within comparatively recent years has it been known that certain bacteria, working in conjunction with legume crops, are responsible for the addition of nitrogen.

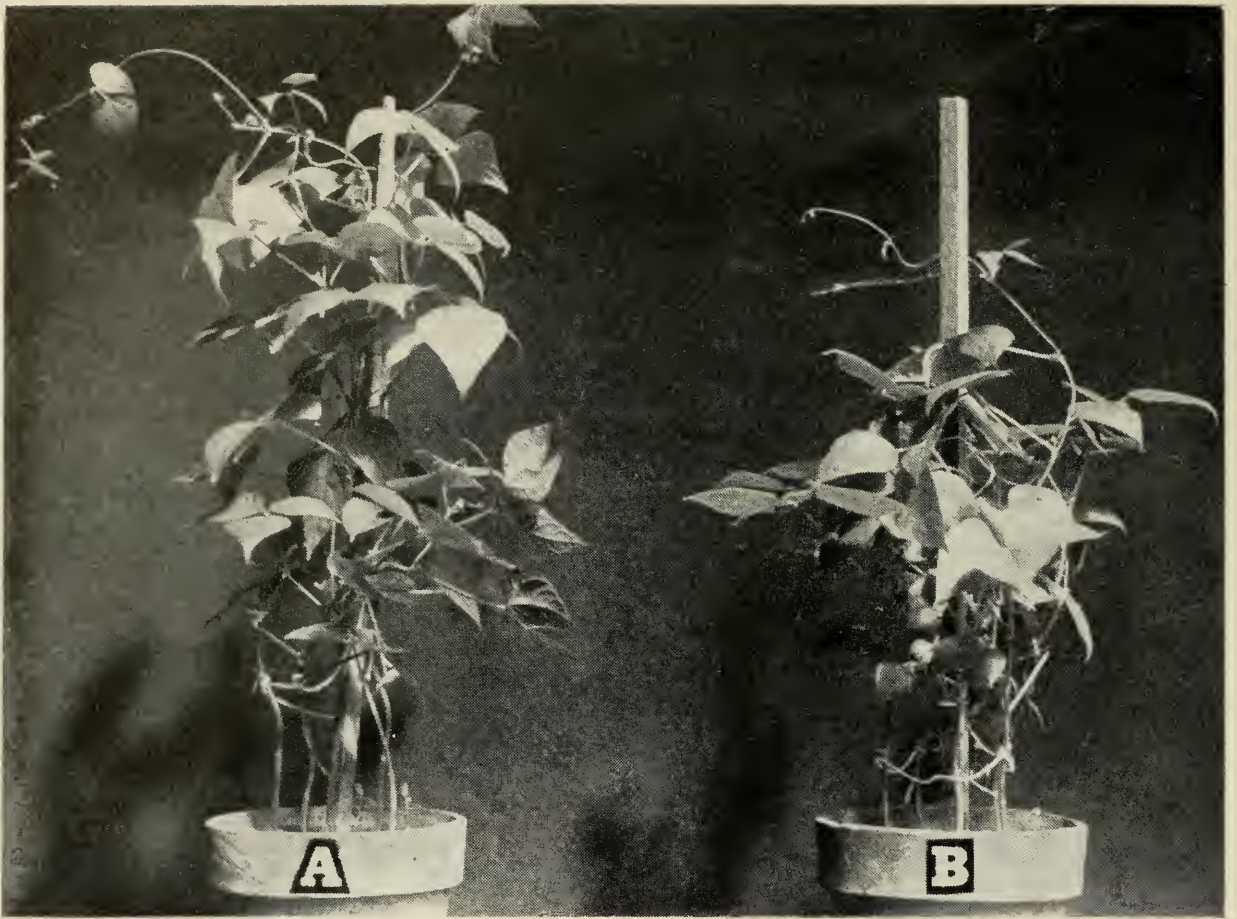


Fig. 4. Legume inoculation. Beans—6 weeks old.
(A) Inoculated, (B) not inoculated. (E.H.G.)



Fig. 5. Legume inoculation. Soybean roots—6 weeks old.
(A) Inoculated, (B) not inoculated. (E.H.G.)

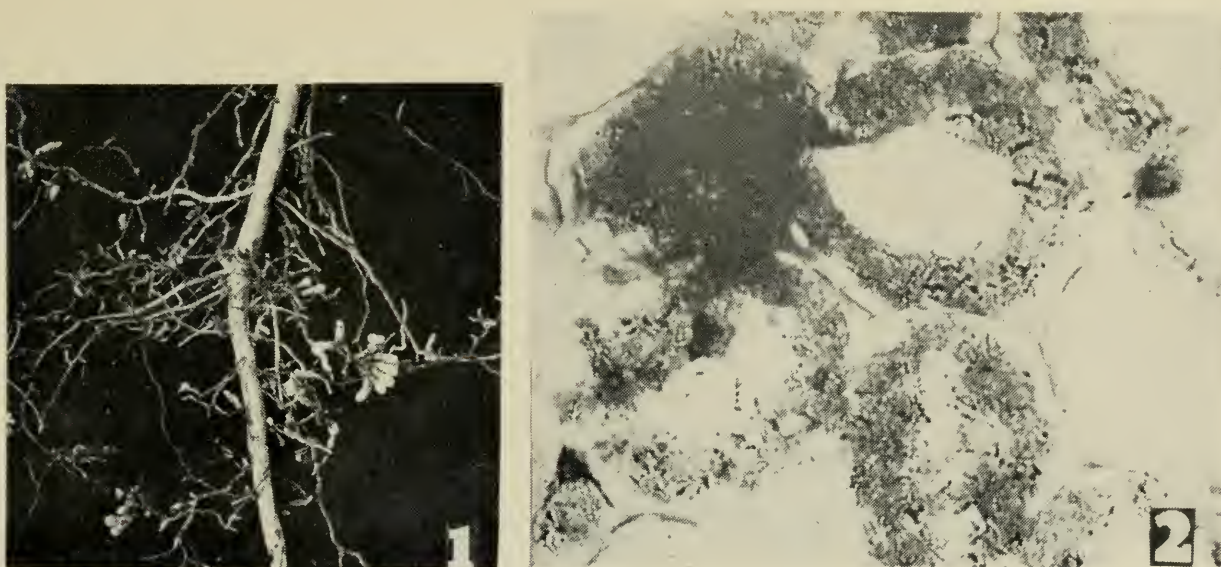


Fig. 6. Legume inoculation. (1) Nodules on alfalfa root, (2) section of nodule from pea root showing bacteria within plant cells. Magnified 1,000 times. (D.H.J.)

Legume bacteria enter the root hairs of a legume plant where they rapidly multiply and become enclosed in swellings called nodules. Here the bacteria “fix” free atmospheric nitrogen and add it to the plant in exchange for food obtained from the plant. This mutual relationship results in increased growth and improved crops. By ploughing under such a crop, not only is the soil enriched with nitrogen but it receives the necessary legume bacteria.

Seed Inoculation — Not all soils contain legume bacteria and they should be supplied by seed inoculation. By this is meant the addition of the bacteria to the seed in the form of a culture. These cultures are supplied in various forms, two of those most commonly used being (1) the pure culture and (2) a mixed, powdered culture. The former is a pure culture of bacteria grown on a jelly-like substance in a small bottle, each bottle supplying sufficient bacteria for one bushel of seed. The bacterial growth, which is in the form of a slimy layer on the surface of the jelly, is removed by adding sweetened milk and washing off the growth with the aid of a flat stick. This is added to a large quantity of milk and is spread on the surface of the seed. When dry, the inoculated seed is ready to sow. This type of culture is distributed by the Department of Bacteriology, O.A.C.

The dried, powdered culture consists of several species of legume bacteria incorporated in a peat or humus base. Although easier to apply, it is more expensive, and the bacteria are perhaps not so plentiful. Seed inoculated with either culture should be sown as soon as possible, and inoculated seed should be kept out of the sun. Although legume cultures may be kept for long periods of time in a cool place, many of the bacteria die and it is best to obtain fresh cultures each season.

While each legume requires a specific species of bacteria, some cultures will successfully inoculate closely allied legumes. Thus an alfalfa culture will inoculate sweet clover and vice versa. On the other hand, the soybean bacteria will not inoculate any other legume. Despite such cross inoculation it is advisable to obtain the specific culture.

Without the accompanying legume crop, the legume bacteria eventually die in the soil, therefore, if the specific legume is not periodically sown every 3-4 years, it will be necessary to inoculate again. Legume bacteria produce the best results in soils lacking nitrogen, where they have been known to add more than 100 pounds of nitrogen per acre. If plants are weak and unthrifty, they should be carefully pulled up, the earth removed, and the roots observed for nodules. If nodules are absent or few and small in size, inoculation is advisable.

REQUIREMENTS OF SOIL BACTERIA

Before a farmer can produce good crops upon which his livelihood depends, he also must produce a good crop of micro-organisms; too often this phase of agriculture is neglected. Bacteria and other forms require certain conditions for their growth and activities, without which they would die. Although many requirements are needed to maintain suitable numbers and types of bacteria in the soil, four of them are particularly essential and they are as follows:

Aeration — Soil ventilation or aeration is particularly important because in the decomposition of organic matter many of the changes brought about by beneficial bacteria are oxidation processes. Air also is needed to supply the necessary nitrogen for nitrogen-fixing types. It also is needed to remove excessive amounts of carbon dioxide in the soil. Sufficient amounts of oxygen are supplied by good drainage and efficient cultivation.

Moisture — Bacteria live and carry on their activities in the thin film of water surrounding each soil particle; therefore it is necessary to maintain the correct moisture content. Excessive moisture causes water logging, driving out the oxygen and preventing the activities of desirable bacteria. On the other hand, extreme drought breaks the moisture film, and the soil becomes air-dry. This prevents bacterial action and many forms die or become dormant. Good drainage carries off excess moisture, and mulching and cultivation prevent evaporation and maintain the required moisture content in dry periods.

Soil Reaction — The majority of bacteria in the soil require a neutral or slightly alkaline reaction as they do not thrive under acid conditions. During the decomposition of organic matter, many species of bacteria produce weak acids, which, if not neutralized, will accumulate and interfere with bacteria activity. Therefore it is necessary to maintain a suitable reaction and if the soil is too acid, lime should be added.

Organic Matter — In order to supply food for bacteria, it is necessary to apply organic matter in some shape or form. Soil micro-organisms obtain their food and energy from such substances and in return liberate available nutrients. Many soils to-day are deficient in organic matter, and it is essential for future crops that the organic material be restored to the soil. It can be applied in the form of green manure or cover crops, crop refuse or residues, manures and composts.

1. **Cover crops** — By this is meant the growing of such crops as rye, clover, soybeans, vetch, peas, etc., and ploughing or disking them under in either fall or spring. Young and succulent plants ploughed under help to maintain the organic matter content, are rapidly decomposed, and supply available nutrients. Older plants, by reason of their fibrous nature, are slower to decompose but supply more organic matter.

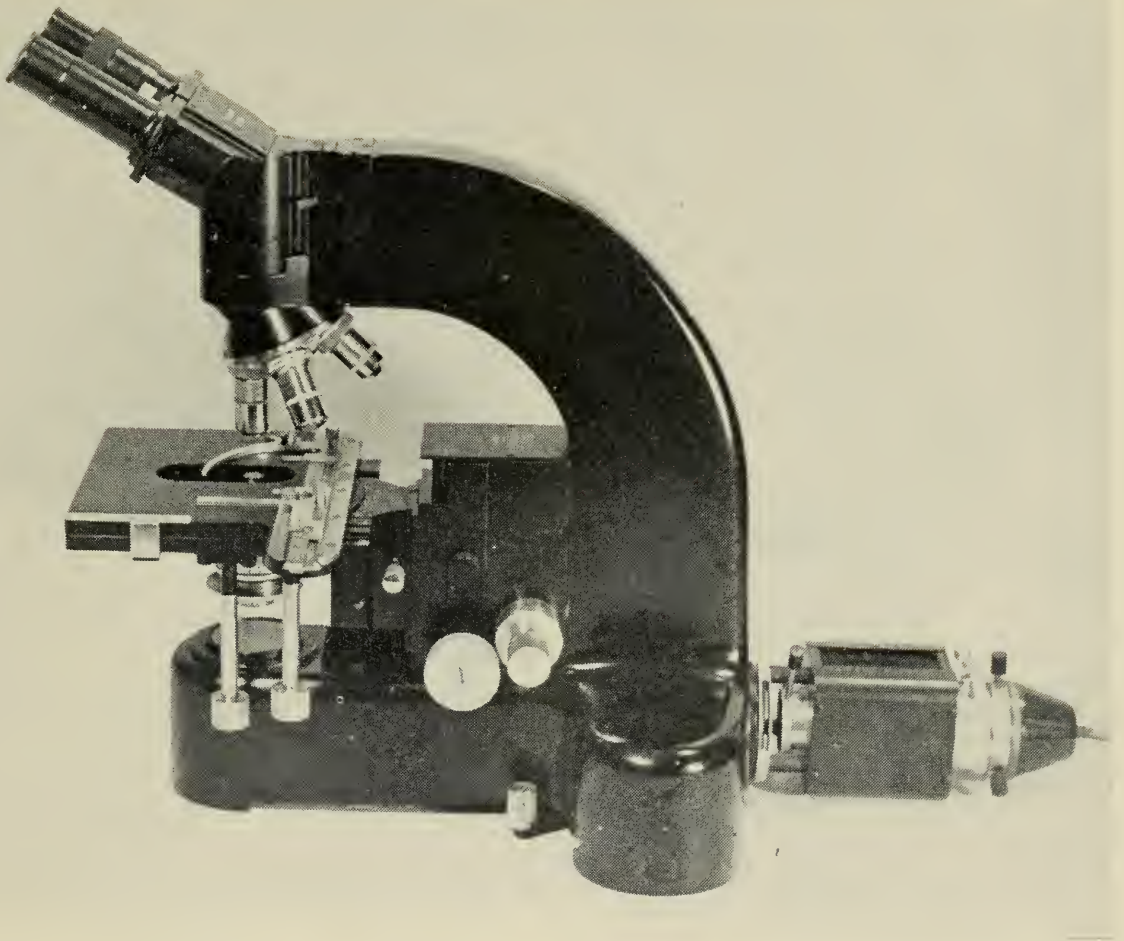


Fig. 7. Modern research microscope. (W.H.B.)

2. Crop residues — Straw, stubble, leaves, etc., are disked under or applied to the surface of the soil. Recent work has shown that straw, hay or weed mulches applied to the surface of the soil not only improve the water-holding capacity of the soil but increase its fertility. Because of the fibrous nature of such mulch materials, they are not quickly decomposed. They supply food for bacteria and assist in making soils more porous and friable.
3. Manure — Manure is a valuable source of organic material. It not only adds nutrients and trace mineral elements to the soil but supplies the soil with countless millions of bacteria. Manure supplies the necessary food for micro-organisms, increases the water-holding capacity and improves the physical condition of the soil. Much of the value of manure is lost if it is improperly piled or stored. Rapid loss of ammonia, "fire fanging" and gas production may be prevented if the manure is firmly packed and kept moist. The liquid portion of manure should not be wasted.
4. Composts — Crop refuse, leaves, grass, sod and other materials can be decomposed by micro-organisms to a desirable state by composting in a prepared bed or heap. By building up layers of such materials with layers of soil and with the occasional addition of a mixed fertilizer, it is possible to manufacture a good supply of rich organic matter for flower

or vegetable garden. The heap must be kept firmly packed and moist. Care must be taken to avoid adding material containing weed seeds or diseased crop refuse. Artificial manures made from straw, by adding certain chemicals and water, have proved to be a rich source of organic material.

BACTERIA AND SEWAGE DISPOSAL

One of the major problems of civilization down through the ages has been the satisfactory disposal of human excreta and industrial wastes. While modern methods now dispose of millions of gallons of sewage per day in large cities, the disposal of human excreta on the farm or in rural areas must be by simple but efficient methods.

Human excreta is composed of waste organic material in process of decay. Each ounce of excreta contains billions of bacteria, many of which are responsible for its putrefaction. If such excreta is allowed to putrefy or decay in exposed places it soon will become an aerial nuisance and serve as a breeding place for flies and other insects. Therefore the main principle of sewage disposal on farms or in rural areas is to dispose of it underground, where it is quickly decomposed by the many numbers and types of bacteria in the soil.

In areas where a water system is not installed, the outhouse or chemical toilet generally is used. The latter involves chemical treatment which destroys the bacteria and dissolves the solids. Although still primitive in form, the outhouse or privvy, when properly located and constructed, is an efficient means of disposing of human wastes. It should be located at least from 75 feet in clay soils, to 200 feet in sandy soils away from the well or water supply. It should be well ventilated and screened, and so constructed that the contents can be regularly and conveniently removed and buried in the soil to a depth of from 6 inches to 1 foot.

SEPTIC TANK METHOD

In villages, settlements and on farms where water is available in the house, the septic tank system is one of the best and most convenient methods of sewage disposal. Although there are many types, those most commonly used are the single and two-chambered types.

Two-chambered Tank — The septic tank may be located as near the house as desired, providing that the absorption bed is at least from 75 to 200 feet, depending upon the nature of the soil, away from the well or source of water. The drainage should not be toward the well.

This type of septic tank is built of concrete or brick and is composed of two chambers, namely: the settling chamber and the discharge or flush chamber. The settling chamber is the larger of the two and receives the raw sewage from the house. This chamber remains full at all times, and while the sewage remains in this chamber it undergoes rapid decomposition, principally by anaerobic bacteria (types acting in the absence of oxygen.) The complex chemical substances are broken down into simple, soluble forms. The undigested portions of the sewage settle to the bottom as sludge, while the liquid portion passes over into the second or discharge chamber. The contents of this chamber usually are

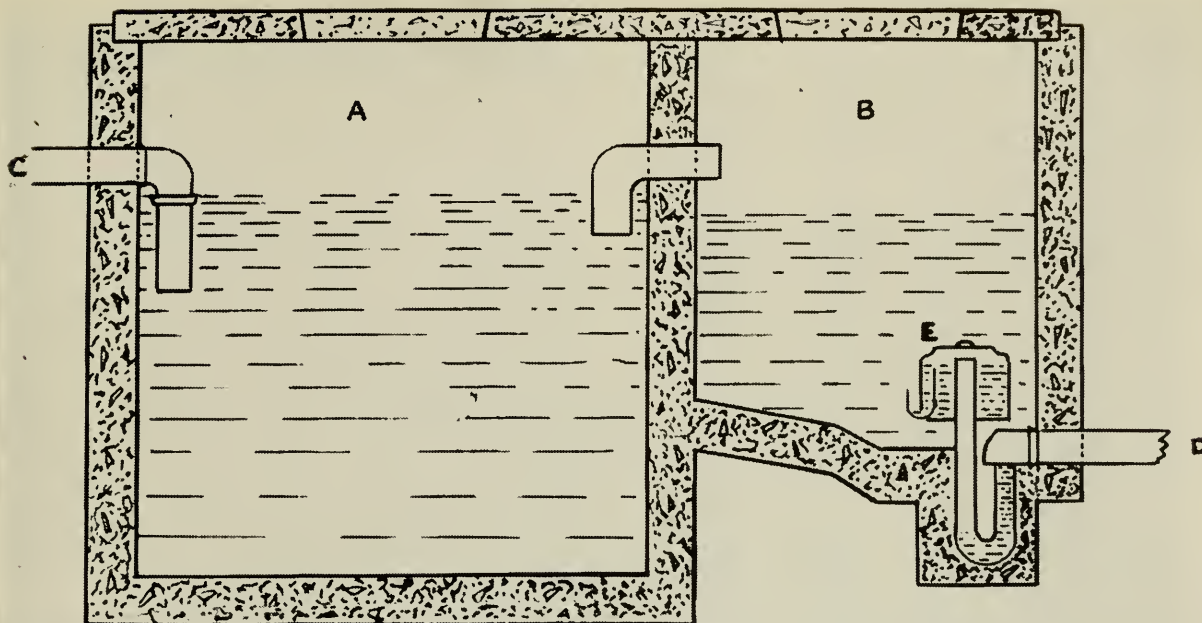


Fig. 8. Two-chambered septic tank. (A) Settling chamber, (B) discharge chamber, (C) inlet, (D) outlet to absorption bed, (E) siphon valve. (E.H.G.)

discharged twice daily by means of a siphon valve. Little bacterial activity takes place in this chamber; what action that does take place is by aerobic bacteria, or types that act in the presence of oxygen.

The liquid portion of the sewage eventually is discharged into the absorption bed, which is composed of weeping tile laid in a bed of gravel or cinders. Here the sewage is absorbed by the soil where it undergoes oxidative changes by the soil bacteria and is decomposed to simple substances available to plants.

Single-Chambered Tank — The single-chambered tank consists of one compartment without a siphon valve. Thus the liquid contents of the tank trickle continuously into the absorption bed each time sewage is added, instead of being discharged at regular intervals as in the two-chambered system. The bacterial action is similar; that is, decomposition by certain types of bacteria working in the absence of free oxygen, followed by final decomposition of the liquid portion of the sewage in the soil.

Tanks may be constructed of concrete built to specifications or treated metal tanks may be procured. However, irrespective of which tank is used, it must be emphasized that no system can be efficient unless a proper disposal or absorption bed is constructed. Information as to size, cost, construction, etc., of a septic tank system can be obtained from Ontario Department of Agriculture Bulletins.

MAINTENANCE AND PRECAUTIONS

A well built and properly located septic tank will prove efficient for many years if correctly treated. A new system will not be efficient until the tank accumulates sufficient numbers of desirable bacteria. It is a common practice to add yeast cake to a new system; this is a mistaken idea as yeasts will not assist the breakdown of sewage in any way. A shovelful of good soil placed in the tank

will assist in establishing the correct bacterial population. The tank should be cleaned and the sludge removed at certain intervals, depending upon the size of the tank. Not more than one foot of sludge should be allowed to accumulate in the tank. When removed, the sludge should be buried or ploughed under in a field and not disposed of in a garden soil.

While moderate amounts of soapy laundry water, washing powders, etc., do not materially interfere with bacterial action, strong applications of lye and disinfectants should be avoided. Disinfectants and cleaning solutions should be sparingly used and should be well diluted, or followed by large amounts of water. Occasional light doses of hydrated lime are beneficial. The addition of too much grease causes a thick scum to form on the surface of the tank; this should be periodically removed.

BACTERIA AND THE WATER SUPPLY

Few natural drinking waters are free from bacteria. Ponds, streams, lakes, shallow wells, etc., contain micro-organisms brought down from the air by rain, snow and hail. Great numbers are added from the soil, while man and animals contribute others. Unless there is a plentiful supply of organic matter in the water, many species do not live for any length of time. However, even the clearest and most sparkling water may contain bacteria harmful to health. Certain species of bacteria are natural to water in which they live and multiply; they are not harmful to health and their presence generally is ignored. Two other groups, however, are important and they are as follows:

Soil Bacteria — Most soils contain countless numbers of different species of micro-organisms, many of which are beneficial, causing necessary decomposition of organic matter. Many of them find their way into wells and other water supplies during floods and rains. They do not cause disease in humans, therefore their presence is not sufficient to condemn a water supply. However, some species are important from the standpoint of food and dairy products; when water containing these bacteria is used in the washing or production of such products, certain abnormalities, off flavours and spoilage may result. These species of bacteria in water supplies are not dangerous, but their presence is not particularly desirable.

Intestinal Bacteria — The intestines of man and animals contain millions of bacteria which are passed out in the bowel discharges. The most common of these is a group of closely related species termed the coliform group. These bacteria do not live for any length of time outside the animal or human body, but their presence indicates intestinal pollution. They find their way into the wells from outhouses, septic tanks, manure piles, polluted soil, etc.

Except under certain circumstances, the coliform bacteria do not cause disease, but their presence indicates that other intestinal bacteria, among which may be disease-producing types, are being discharged into the water supply. Typhoid fever and dysentery, for example, are intestinal diseases, and the bacteria causing them are eliminated in the bowel discharges. As it is easier to isolate and identify coliform bacteria than it is disease types, water supplies are tested for the presence of the coliform group. When these types are found it does not necessarily mean that disease bacteria are present, but the water is

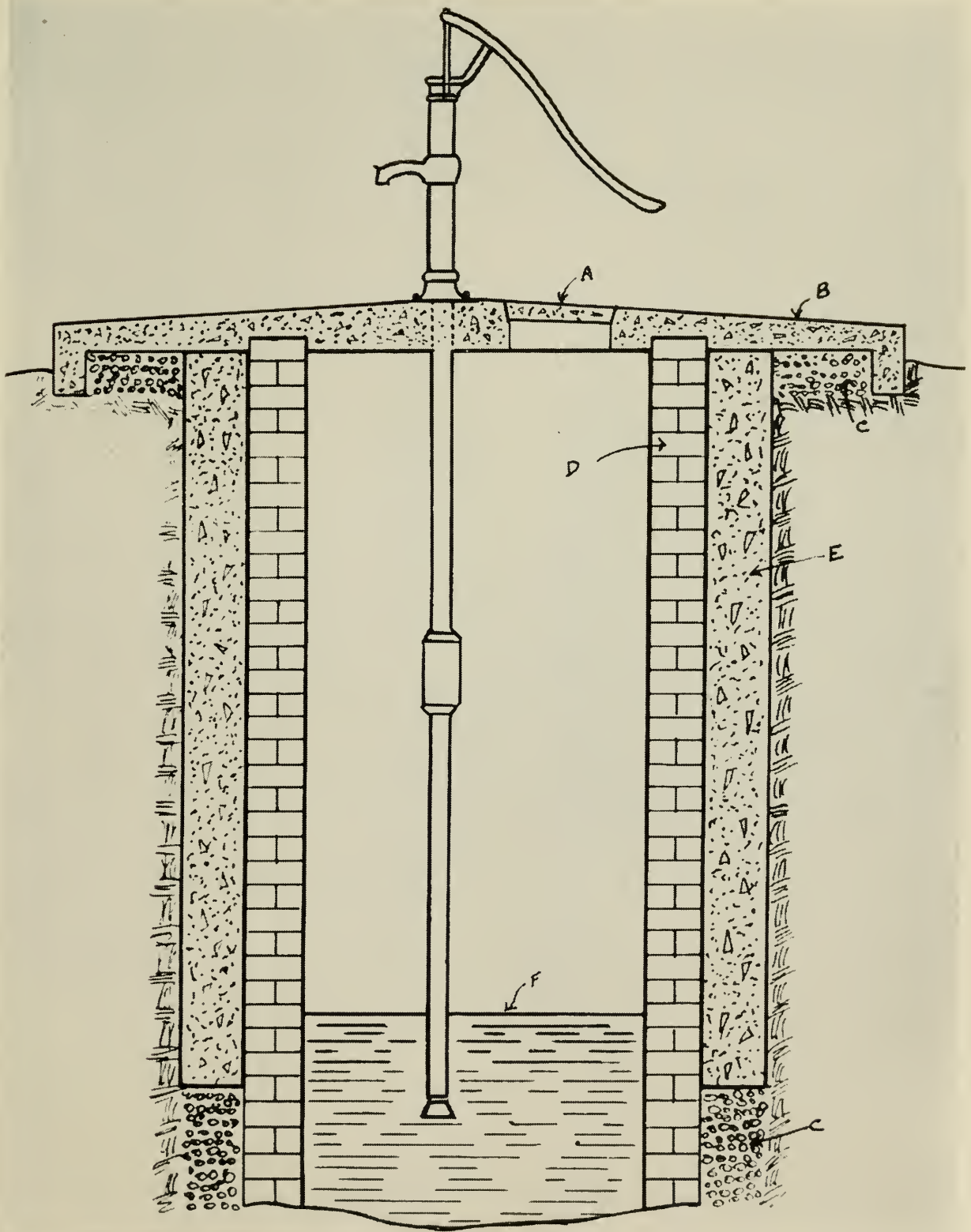


Fig. 9. Properly constructed well. (A) Man-hole, (B) sloping cement top, (C) gravel, (D) inside brick wall, (E) outside cement wall occupying upper 10-12 feet, (F) water level. (E.H.G.)

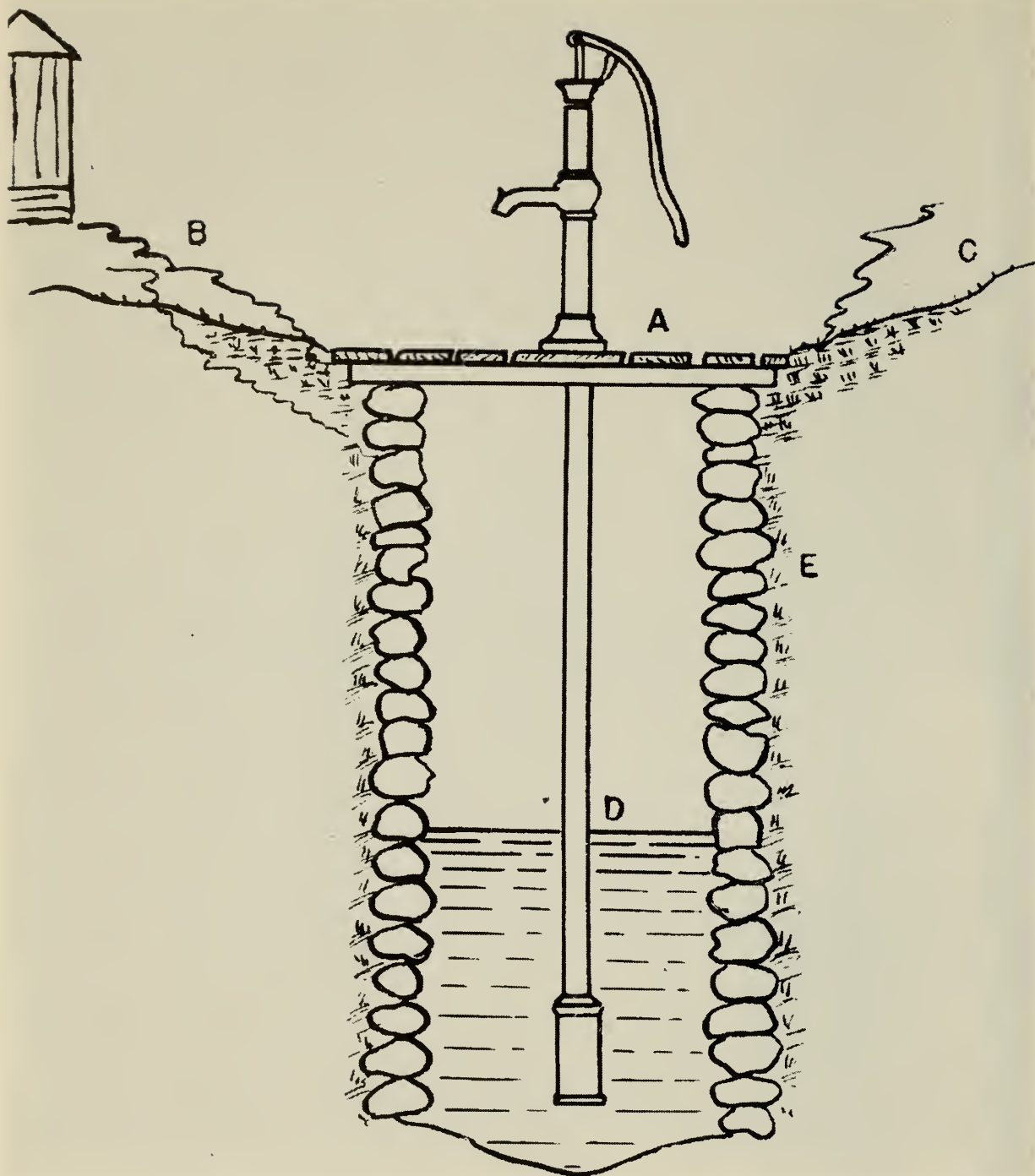


Fig. 10. Improperly constructed and poorly located well. (A) Poor type of wooden top, (B) and (C) slope toward the well, allowing seepage from polluting sources, (D) water level, (E) loosely constructed stone wall, allowing seepage from surrounding soil to enter well. (E.H.G.)

unfit for human consumption unless boiled or chlorinated, because if coliform bacteria can find their way into water supplies, so can the bacteria causing intestinal diseases.

PREVENTION OF POLLUTION

Pollution in wells may be avoided in many cases by the wells being properly constructed and suitably located. Many wells in rural districts are situated too close to sources of pollution, and many of them are poorly constructed. The

chief offender is the open, shallow well with poor top and porous walls; this type of well should be avoided.

Location — Wells should be located as far as possible from polluting sources. No one safe distance can be advocated because of the differences in soil structure. Where the soil is clay, a distance of 75 to 100 feet from outhouse, septic tank, etc., should be sufficient, whereas in sandy or gravelly soils at least 200 feet are required. The well should be situated on the highest point of land possible; when the surface of the water is at least at a higher level than any nearby polluting source, the water is safe from surface pollution. The drainage should be away from the well; too many farm wells are situated in hollows and depressions with the drainage from polluting sources directly towards them.

Construction — Various types of wells include: shallow and deep dug wells, bored wells, drilled wells and driven or sand point wells. With the exception of the driven type, a good well is finished by casing with iron or steel, pipe, brick, concrete, tile, etc. The upper 10 or 12 feet of the walls of a shallow or deep dug well should be made impervious to the entrance of water. This is accomplished by using brick, concrete or tile. In this way, surface water has to filter through 10 or 12 feet of soil before it can enter the well. Such filtration frees the water of bacteria.

Good location and proper construction are wasted if little or no attention is paid to the top of the well. Many excellent wells are spoiled by the tops being made of a few rotten, badly fitting boards or planks, through which manure, filth, dirt and insects may enter. The top should be placed upon walls that are finished above ground level. A good top preferably should be built of concrete with a suitable, tight man-hole. It should slope to the outside, and the earth should be graded away from the curb in order to carry off waste water. Occasionally a catch basin below the spout of the pump is built and connected to the "run-off."

Farm and school well waters in Ontario will be tested upon application to the Department of Bacteriology, Ontario Agricultural College, Guelph.

MICRO-ORGANISMS AND MILK

Milk is a complex mixture of substances which forms a satisfactory food preparation. It is, therefore, an ideal medium for growth and multiplication of bacteria, yeasts and moulds that will cause its rapid spoilage under certain conditions.

The interior of udders of normal cows are seldom free from bacteria, which usually are found in the first milk drawn; therefore milk is rarely sterile as it comes from the cow. Unless disease-producing, these bacteria are not as important as those that may enter the milk from other sources. There are various sources on the farm and in the dairy from which many types of organisms may find their way into milk during the operations of milking and handling. Chief among these on the farm are: the cow, bits of straw, hay and manure, dust, flies, cans and utensils, milking machines, hands and clothing of milkers, etc. Bacteria from such sources can be avoided by grooming and washing cows, keeping the stable clean, by not bedding, sweeping or feeding

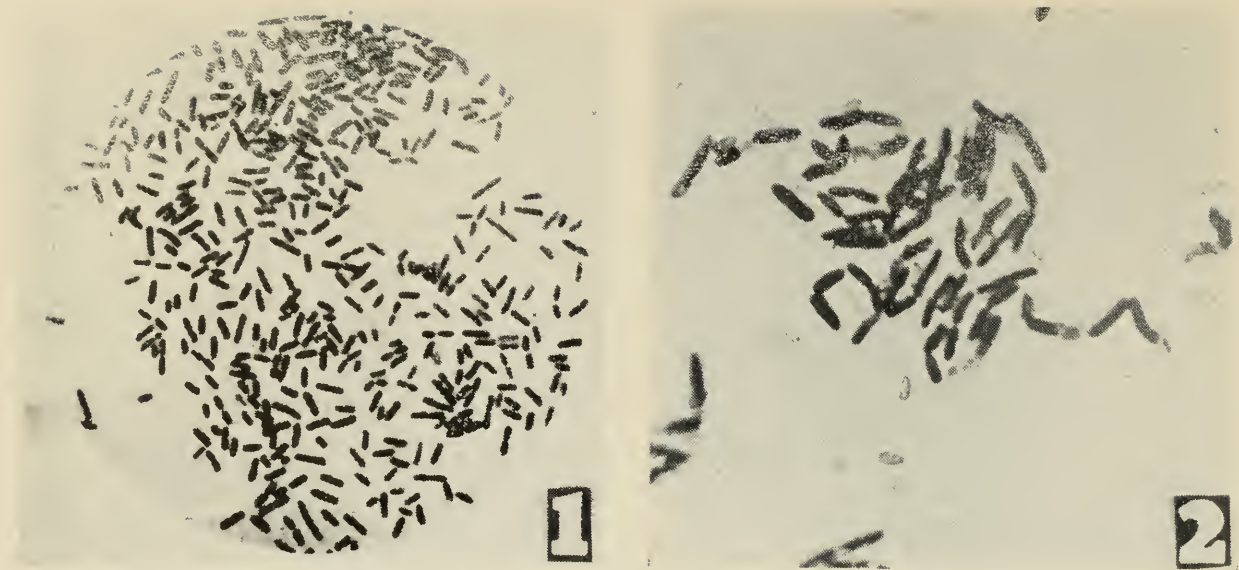


Fig. 11. Undesirable bacteria in milk. (1) Coliform bacteria, indicating contamination from manure, (2) large spore-forming rods from hay, straw and dust. (D.H.J.)

at time of milking, by keeping flies away from the milk, by correct washing and sterilizing of utensils and milking machines and by maintaining clean hands and clothes. High bacterial counts in milk can be avoided if clean and sanitary conditions prevail.

TYPES OF MICRO-ORGANISMS IN MILK

Micro-organisms found in milk can be divided into various groups, among which are three of particular importance. These are: bacteria causing desirable fermentations, those responsible for undesirable changes or fermentations, and disease-producing types.

1. Lactic Acid Starters — Certain of these bacteria find their way into milk from dust, air, manure and other sources. When the numbers are great enough, they cause the milk to sour and form an acid curd. This constitutes the normal souring of milk and, when these bacteria are grown under controlled conditions, they produce desirable lactic acid cultures, termed starters, used for butter, cheese and cultured buttermilk manufacture.

2. Acidophilus Milk — Bacteria responsible for this type of fermentation may find their way into milk from various sources and, if properly cultivated under controlled conditions, produce an acid curd milk of higher acidity than that produced by the common lactic acid type. Acidophilus milk is used for medicinal purposes.

3. Bulgarian Milk — When properly cultivated under laboratory conditions, these bacteria produce a high acidity in milk. Cultures of this organism are used in the preparation of certain eastern milk beverages.

UNDESIRABLE FERMENTATIONS

1. Ropy Milk — This is a common source of trouble on the dairy farm—especially in the summer. The milk is changed from its fluid state to a thick, slimy or viscid condition, whereby it can be stretched in ropy strands. Such a condition is caused by bacteria that are enclosed in gelatinous capsules and, when they are present in certain numbers, they cause the milk to become

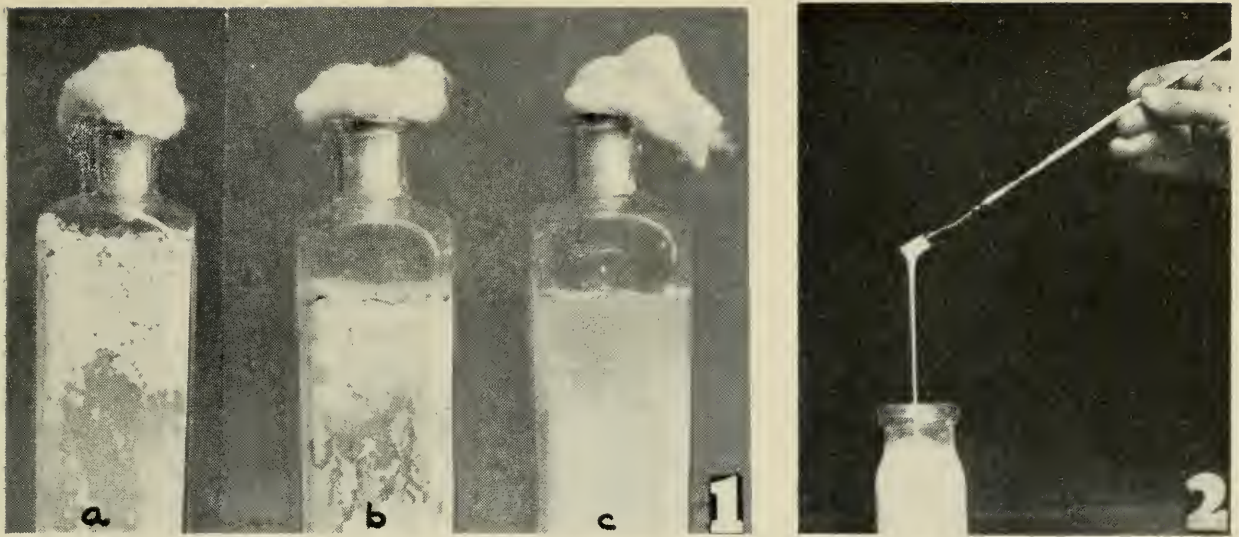


Fig. 12. Undesirable fermentations in milk. (1) Milk spoiled by addition of (a) dust, (b) bit of straw and (c) a single fly. (2) Ropy milk. (Lund and E.C.B.)

ropy. The bacteria do not originate from the interior of the udder as commonly believed, but are found in water, cisterns, cooling tanks and on the coats of cows. The trouble should be eradicated as soon as possible by sterilizing all utensils, and the stable should be thoroughly cleaned and disinfected.*

2. Sweet Curdling — Occasionally milk will curdle with a sweet or soft curd, unlike normally soured milk which is acid. It is caused by certain spore-forming bacteria that possess the ability to coagulate milk. These bacteria are found on hay, straw, manure and dust. This type of undesirable fermentation generally is found in pasteurized milk, because pasteurization temperatures do not kill spore-forming bacteria. The presence of sweet curdling usually indicates dirty or dusty conditions in the stable at the time of milking, or the use of improperly sterilized utensils.

3. Gassy Milk — Certain species of bacteria, when present in sufficient numbers, are capable of producing gas as well as acid in milk. This is a highly undesirable type of fermentation and is the result of milk being contaminated with intestinal bacteria from manure, unclean utensils or insanitary persons.

4. Alcoholic Milk — Certain yeasts are capable of forming alcohol and carbon dioxide gas from milk sugar. Such yeasts are found in the atmosphere, on dust, organic matter and other sources. This fermentation is more commonly found during the summer months.

5. Bitter Milk — When certain species of bacteria, some of which grow at low temperatures, contaminate milk they are capable of producing bitter flavours. Such bacteria are found on hay, straw and dust and may produce bitter flavours when the milk is stored at cool temperatures.

6. Coloured Milk — Several known species of bacteria contaminating milk are capable of changing the colour of milk into shades of red, blue or yellow. These and other fermentations, such as "soapy," "fruity," etc., are produced by various species of bacteria, the presence of which in milk can be avoided by clean and sanitary precautions.

*Water will be tested for the presence of ropy milk bacteria upon application to the Department of Bacteriology, O.A.C., Guelph.

DISEASE BACTERIA

Whereas various fermentations in milk may be detected by appearance, taste and smell, it is impossible to detect disease bacteria in milk, as they usually do not produce any abnormal changes. Disease bacteria in milk originate from diseased cows or from persons handling the milk.

From Cows — Three important diseases of cattle that may affect humans are tuberculosis, mastitis and contagious abortion. The bacteria causing bovine tuberculosis may be found in infected udders or in manure from infected cows. Children especially may contract the disease by drinking raw milk. Mastitis is a disease of the udder caused by one or more species of bacteria, some of which are capable of causing septic sore throat in humans. Contagious abortion is a disease of cows causing premature abortion of the calf. Raw milk may contain the disease bacteria and produce undulant fever in humans. There are other diseases in this group but they are rarely encountered.

From Humans — There are numerous diseases originating from humans that are milk-borne. Such intestinal diseases as typhoid and paratyphoid fevers, cholera, dysentery, diarrhoea and summer complaint are caused by the disease bacteria gaining access to the milk from infected carriers with insanitary habits. Humans infected with these diseases should not be allowed to participate in milking, nor be allowed to handle milk or milk products. Many of the bacteria causing these diseases rapidly multiply in milk.

Such diseases as diphtheria, scarlet fever and septic sore throat are caused by bacteria originating in the throat, nose and other infected parts of the human body. Coughing or sneezing during milking operations may add many bacteria to the milk. These and other more uncommon diseases may be prevented by allowing only healthy and clean individuals to handle milk and milk products.

PREVENTION OF SPOILAGE AND DISEASE

In addition to clean and sanitary conditions in stable, milk house and dairy, it is necessary to safeguard milk for human consumption by properly sterilizing cans and utensils, by efficiently cooling the milk and by pasteurizing the milk to kill the disease bacteria.

Cleaning and Sterilizing Utensils — Unclean cans, strainers, utensils, etc., contain many numbers of micro-organisms that may considerably add to the contamination of milk. Therefore, it is essential that all utensils should be free from open seams and rust and be carefully cleaned and sterilized.

All utensils or containers that have contained milk should be thoroughly rinsed with cold or lukewarm water to remove all milk film or residue. After rinsing they should be scrubbed with hot water containing a reliable detergent or washing compound with the temperature of the water not less than 110° F. This should be followed by a hot water rinse. Where steam is available the containers should be steamed or scalded and quickly dried in a dust-free atmosphere. Where steam is not available the containers should be rinsed with a chlorine solution just before milking. The amount of chlorine should not be less than 100 parts per million. Chlorine is not effective if used on dirty or unwashed utensils. Pails should never be dried with a towel, nor should they be given a final rinse with cold water that may contain undesirable bacteria.

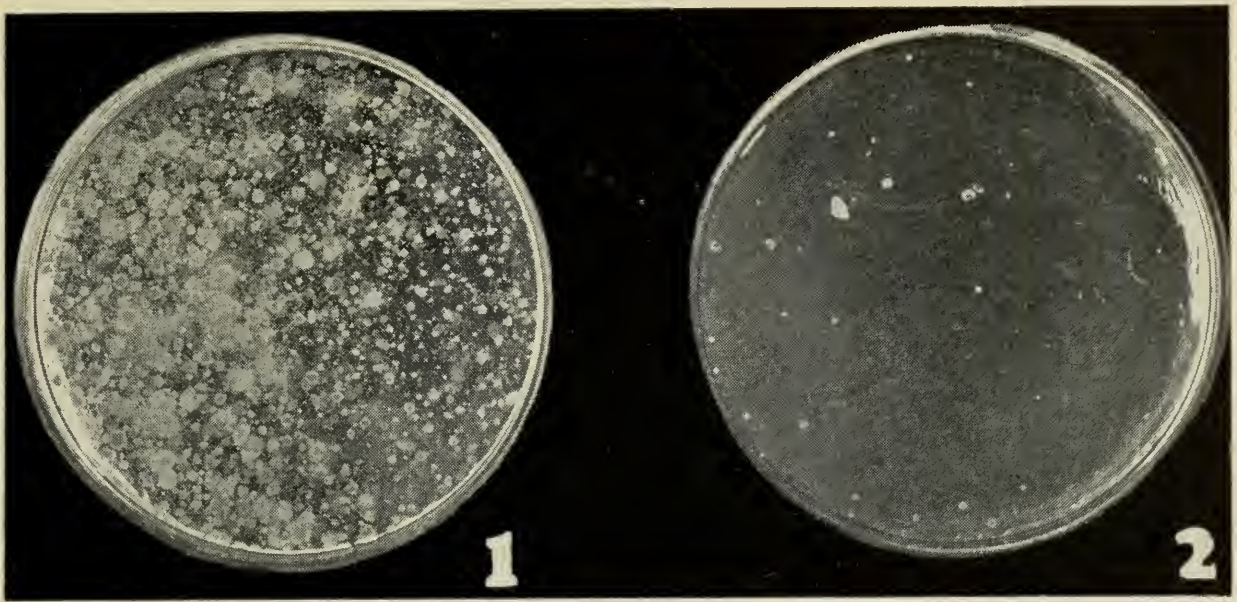


Fig. 13. Effects of pasteurization. Bacterial colonies obtained from a sample of milk (1) before pasteurization and (2) after pasteurization. (D.H.J.)

Care of the milking machine is very important. At the conclusion of milking, the unit should be flushed by drawing through cold or lukewarm water. Pail head and milker pail are cleaned in the usual way. Teat cups and rubber tubing are filled with a solution of 0.5% common lye and hung on a rack. Before the next milking the parts are drained and re-assembled; it is not necessary to rinse the tubes.

COOLING MILK

The temperature of milk, as it is drawn from the cow, should be reduced as quickly as possible. Therefore, an efficient cooling system is essential. By holding the milk at a temperature of between 40° F. and 50° F. it is possible to prevent the rapid multiplication of many species of bacteria that may have gained access to the milk during the milking operation. Holding the milk at such a temperature does not prevent all bacteria from growing; certain species prefer low temperatures, but temperatures below 50° F. prevent the growth of most types likely to cause spoilage.

PASTEURIZATION

By pasteurization is meant the heating of milk at a certain temperature for a specified length of time in order to destroy the disease bacteria and yet not affect its chemical or physical properties. In view of the many disease bacteria from animals and humans which may find their way into milk, pasteurization is the only safe method of making milk safe for human consumption. Two main methods of pasteurization are employed, namely: the "holding" method whereby milk is heated at a temperature of at least 143° F. for 30 minutes, and the H.T.S.T. (high temperature, short time) method which employs a temperature of at least 160° F. for 15 seconds.

Efficient pasteurization does not impair the flavour of the milk, nor does it noticeably affect the food value. It does, however, eliminate the possibility of diseases originating from milk and thus particularly safeguards the health of children.



Fig. 14. Culture dishes used to determine types and numbers of bacteria in milk and other products.
(D.H.J.)

MICRO-ORGANISMS AND FERMENTATIONS

Many species of bacteria are able to change sugars into various substances, chief among which are organic acids. These changes are brought about by a process known as fermentation, and the acids produced are particularly important because of their preservative effect. Their presence in food products prevents the growth and multiplication of certain spoilage bacteria which cannot grow under acid conditions. Examples of products being preserved by such fermentations are: silage, sauerkraut and vinegar.

SILAGE

Ensiling is the process by which any crop may be preserved by storing it in a silo where it undergoes fermentation. Corn is the most commonly used crop for silage purposes, as it contains sufficient sugar for immediate fermentation. Many other crops do not contain sufficient sugar and, for successful ensiling, either sugar has to be added in the form of molasses, or acids are added directly to the crop. Excellent bulletins on the ensiling of crops other than corn may be obtained from various experimental stations. The manufacture of corn silage is not difficult providing certain principles are followed. That they are not always followed is borne out by the many samples of spoiled silage received for examination at the laboratory from time to time.

Bacterial Fermentation — The leaf surfaces of corn as it comes from the field contain many numbers of micro-organisms, some beneficial, others harmful. When corn is cut at the right time, contains sufficient moisture and is correctly packed, bacterial action immediately commences. The natural enzymes in the plant also assist by changing starches into sugars. There is an increase in temperature, and gas is liberated. The chief fermentation is a process whereby the sugars are changed into various organic acids, chief among which is lactic acid. A certain amount of alcohol is formed which in time is changed to acetic acid by acetic acid bacteria. Once these acids are formed, spoilage bacteria, which also are present in great numbers, cannot function, and the silage may be preserved indefinitely.

Air must be kept out of the silage because many moulds, present on leaves and stalks, prefer acid conditions and, in the presence of air, soon turn the silage mouldy and unfit for animal consumption. In order to supply the conditions necessary for the successful ensiling of corn, care must be taken in the cutting, watering and packing operations.

Cutting of Crop — Successful corn silage greatly depends upon the state of the corn when cut. If possible, corn should be cut when the grains are dented and the lower leaves and husks are beginning to dry up. The stalk, however, should be full of sap. These conditions are reached approximately one week to 10 days before the corn is ready to be shocked. At this particular stage the corn will contain sufficient moisture and maximum food nutrients. Cutting green or immature corn may result in a somewhat sour silage, high in moisture.

Corn should be cut into particles not more than 1 inch in size, about $\frac{3}{4}$ inch being the accepted size. The pieces should be evenly mixed, preferably by means of a distributor; if not, the lighter, fluffier pieces will settle on the outside.

Adding Water — If corn is cut at the correct time and packs properly, water need not be added. The later the corn is left in the field, the drier and fluffier it becomes, with the result that it will not pack properly and water should be added. It is impossible to advise the amount of water to be added, as it will depend upon the state of the corn. However, it is difficult to spoil corn silage by adding too much water; therefore water should be added when in doubt. The best method of adding water is to run a stream of water into the blower. If this is not possible, water can be added in the silo, providing it is well distributed. More water should be added to the silage on the top than to the silage lower down.

Packing the Silage — It is important that the corn be well packed in order to drive out the air. This is done by piling the silage towards the walls of the silo, tramping thoroughly and then filling and tramping the centre. Silage settles from day to day and, unless properly packed, will pull away from the walls. Less tramping is necessary if the silo is slowly filled; the upper half of the silo requires more tramping than the lower half. In order to avoid loss in the upper surface of the silage, the filled silo should be sealed with wet straw or other such material.

Mouldy Silage — This is the most common form of silage spoilage. It may occur in pockets, near the walls or surface, or throughout certain areas. Mouldy silage may be pink, green, white, etc., depending upon the predominant species of moulds. It may result from one or more of the following causes:

1. Corn too fluffy—cut too late in the season.
2. Corn cut in too large pieces and not properly distributed.
3. Insufficient amount of water.
4. Poor packing.
5. Cracks or imperfections in the silo, allowing entrance of air.
6. Imperfect seal on silo top.

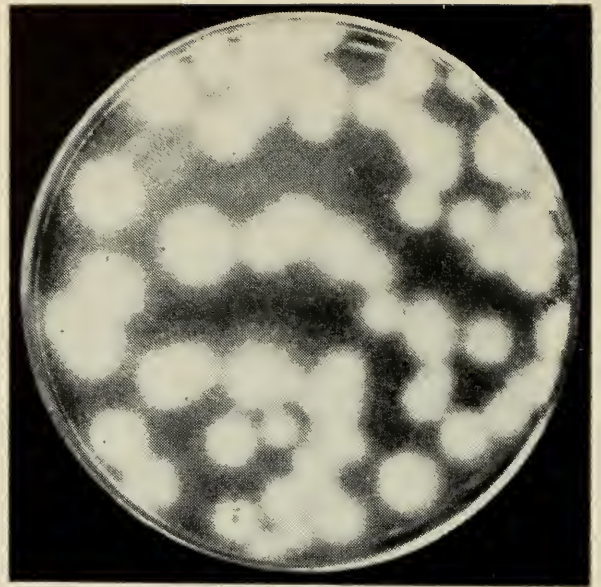
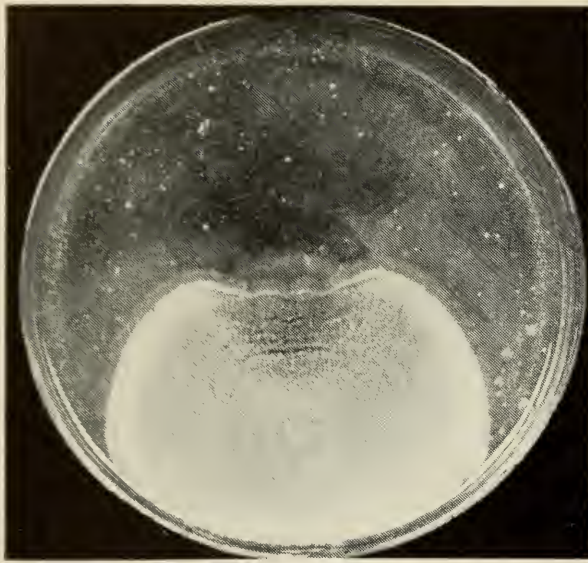


Fig. 15. Common moulds found in mouldy silage. (W.H.B.)

MOULDY SILAGE SHOULD NOT BE FED ANIMALS

Spoiled Silage — This refers to silage that is partially decomposed and possesses evil odours. It is caused by spoilage bacteria functioning before the desirable acid-producing types; such spoiled silage can occur in any crop deficient in sugar or in resultant acids. Also, it can occur in silage where the acids are reduced as a result of mould action.

VINEGAR

Vinegar may be made from many fruits and vegetables, but the most common are apples, grapes and honey. The production of vinegar is an excellent way of utilizing products that otherwise would go to waste. Vinegar is dependent upon the action of both yeasts and bacteria, and its production takes place in successive steps whereby fruit juices or sugary solutions are turned into alcohol by yeasts and the alcohol turned into acetic acid by bacteria. Cleanliness and care are essential in making a good grade of vinegar, which should contain from 4% to 8% acetic acid. As apples are most commonly used on the average farm, the following directions apply particularly to that crop.

SWEET CIDER

Choice of Apples — The quality and flavour of vinegar will depend a great deal upon the original sweet cider. Mixed, decaying and dirty windfalls will not be a suitable product to change into vinegar. Only sound, ripe apples should be used; over-ripe or green apples should be avoided. Various flavours of ciders and vinegars depend upon the varieties used. For example, Red Astrachan, Yellow Transparent and Duchess impart a tart acid flavour; Wealthy, Baldwin and Spy yield a milder flavour; while Snow, McIntosh and Delicious give an aromatic flavour.

Apples should be sorted, and those showing signs of decay and worminess should be discarded. Decayed apples add countless numbers of undesirable organisms and may spoil the vinegar. However, sound apples with bruises,

scars, scabs, limb rubs, etc., do not affect the product. The apples should be thoroughly washed in a tub or vat, stirring and frequently changing the water. Washing should not precede pressing by more than 24 hours and it is desirable to press as soon as possible after washing.

Extraction of Juice — After thorough washing, the apples are ground in a cider mill or grated on cylindrical graters or rollers. The resultant pulp is added to cleaned and boiled canvas or sugar sacks and pressed in a cider press. The juice is then collected in clean enamelled or wooden containers; metal containers should not be used. Juice should be strained through clean cloth to remove the "pomace" or coarse particles and allowed to stand in a cool place for 12 to 15 hours. After standing, the clear liquid may be siphoned off. Where large bulk amounts of cider are made, the cider may be further clarified by the addition of a precipitating agent, such as gelatin.

Up to this point, neither yeast nor bacterial action has taken place and it is essential that, by cleanliness and care, micro-organisms must be kept out to avoid undesirable fermentation. If the juice is to be maintained as sweet cider it can be preserved, either by adding $1\frac{1}{4}$ ounces of sodium benzoate to each 10 gallons of cider, or by pasteurizing at 175° F. for 20 minutes.

HARD CIDER

Preparation of Barrel — After sweet cider is cleared it should be run into a suitable barrel. It is very necessary that only clean and sterilized barrels be used. The barrel should be soaked with water for a day or so to soften dried material, then rinsed several times and steamed for 15–20 minutes. If steam is not available, the barrel can be soaked and cleaned, then filled with hot water to which is added 2 tablespoonfuls of hypochlorite of lime, or other suitable chlorine product, and left standing for several hours. It should be emptied and rinsed several times with good clean water to eliminate residual chlorine.

Alcoholic Fermentation — Sweet apple juice is added to the barrel until it is approximately three-quarters full; the barrel is then laid on its side. There should be a bung hole at each end and at the top. Yeasts are responsible for changing sugar solutions into alcohol, and while yeast present on the skins of apples are capable of forming alcohol, it is not advisable to depend upon their action, as poor results may be obtained. It is advisable to add a pure culture of yeast and, while commercial yeast cakes may be used, it is better to use yeasts propagated for such purposes.* Once the yeast is added, the bung holes should be covered with cheesecloth to keep out dust and contamination. The barrel is kept at a temperature of 65° to 75° F. for about 3 weeks, after which alcoholic fermentation should be complete.

VINEGAR

Acetic Acid Fermentation — Vinegar from hard cider or other alcoholic solutions is produced by certain bacteria that have the ability to turn alcohol into acetic acid in the presence of oxygen. These bacteria are found on fruits, in the air and other places, and while these wild and mixed types may produce a type of vinegar, the final result is uncertain. It is better to depend upon pure cultures of vinegar bacteria, termed starters.*

**Cultures of wine yeasts and vinegar bacteria may be obtained from Department of Bacteriology, O.A.C., Guelph.*

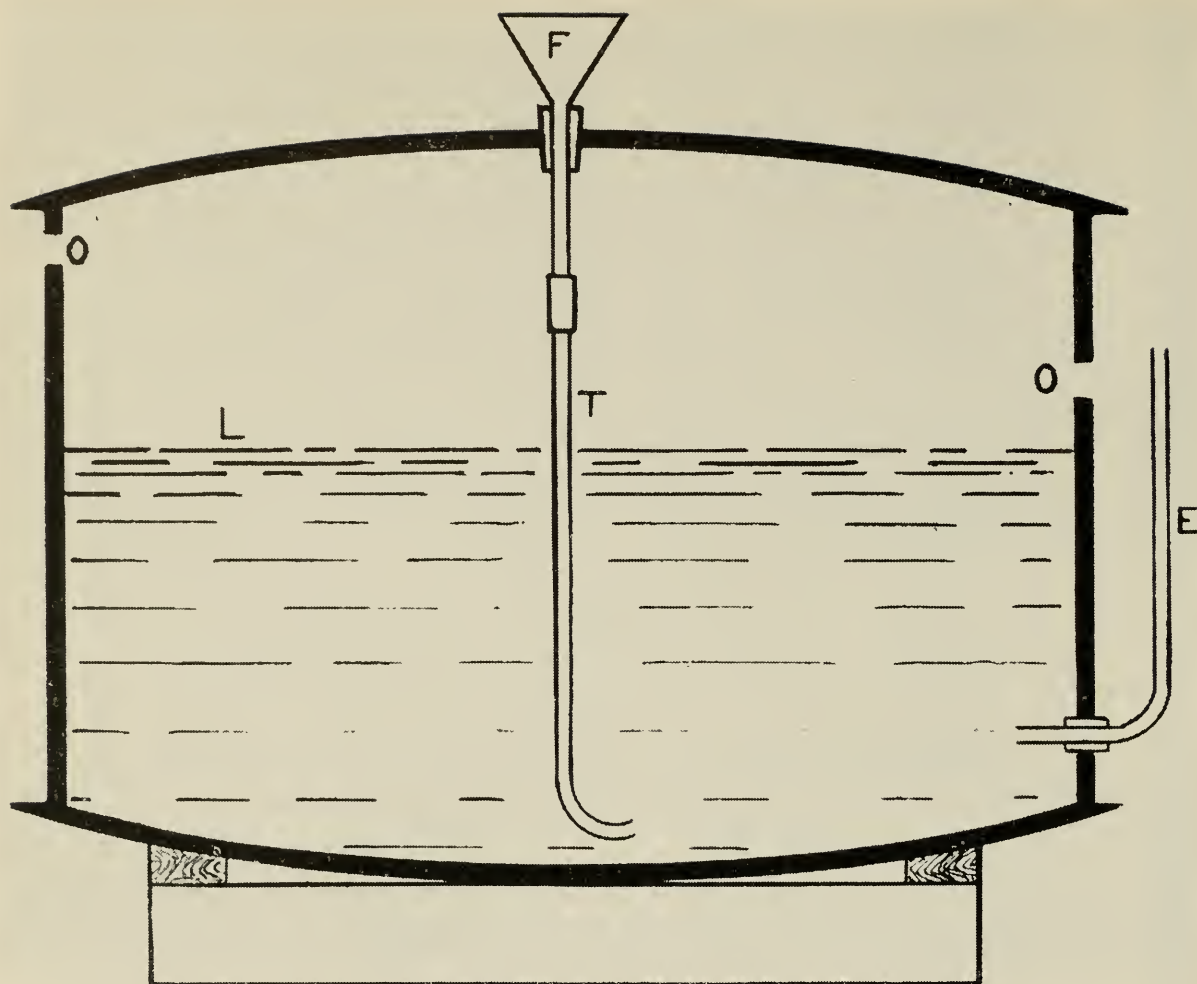


Fig. 16. Vinegar barrel. (L) Surface of cider, (O, O) openings for air, (F) funnel in stopper, (T) glass tube attached to funnel down which new supplies of cider are added without disturbing surface film, (E) glass tube to show level of liquid and for withdrawing vinegar. (After Marshall.)

The hard cider is run into a freshly cleaned and sterilized barrel until it is approximately two-thirds full. The vinegar starter is added and several layers of cloth are placed over the bung holes. The barrel should be maintained at a temperature of between 65° to 75° F. until vinegar of sufficient acetic acid content is produced, which usually takes 2 months. A continuous home-made method may be used by constructing a barrel as shown in the illustration. The alcoholic liquid may be added and the vinegar drawn off without disturbing the vinegar bacteria, which are in the form of a thin gelatinous film on the surface. This film must not be disturbed because, requiring oxygen, if it sinks below the surface of the liquid, acetification is stopped until a new film is formed.

Storage — Vinegar drawn from undisturbed barrels should be clear enough for bottling. It should be put into clean and sterilized bottles, corked and pasteurized by heating in a water bath at a temperature of 140° F. for 20–25 minutes. Properly pasteurized vinegar will keep for years. Vinegar can be drawn off from the barrel and stored in bulk; sterilized casks, etc., should be filled, bunged and stored in a cool place.



Fig. 17. Lactic acid producing bacteria found in sauerkraut.

SPOILAGE

Off Fermentations — Any “off” or disagreeable flavour may be the result of undesirable micro-organisms gaining entrance sometime during the process. Dirty or dusty equipment, unwashed fruit and carelessness during the various operations are responsible for such changes.

Surface Film — If fruit juice or alcohol is exposed to the air for any length of time, it will develop a thick and wrinkled film. This is caused by certain yeasts which eventually will destroy the alcohol and acid.

Vinegar Eels — These are small worms, barely seen with the naked eye. They originate from surface water and are found in and near the vinegar barrel. They may cause the vinegar to spoil when they die in the vinegar. Properly pasteurized vinegar, kept sealed, should not contain eels.

SAUERKRAUT

Sauerkraut is another example of a food product preserved by organic acids produced by desirable bacteria. The preserving of cabbage by this method is an old custom and, providing directions are carefully followed, an excellent sauerkraut can be manufactured.

Procedure — Although sauerkraut made from late cabbages generally is regarded to be of superior quality, equally good sauerkraut may be made from sound, early maturing varieties. Only mature and sound cabbages should be selected; dirty and green outside leaves should be removed and clean white heads used. Long, thin shreds should be cut with either a shredding machine or large knife. The finely cut cabbage is packed in clean stone jars or crocks, or in sterilized wooden kegs if larger amounts are desired.

Layers of cabbages several inches thick are alternated with layers of salt. One pound of salt to each 40 or 50 pounds of cabbage is needed to produce the right amount of brine. The cabbage should be firmly packed. A clean, wooden cover is placed on the top of the salt-cabbage mixture and weighted heavily enough to cause the liquid brine to reach the cover. A clean cloth may be placed between the cabbage and the wooden cover if desired.

Fermentation — Length of time of fermentation depends upon the temperature; the lower the temperature, the longer the period. The best tempera-

ture is regarded to be between 65° F. and 70° F., at which temperature fermentation will require from 3 to 4 weeks. Fermentation begins almost immediately; the salt causes extraction of the cabbage juices, and in the resultant brine the large numbers of micro-organisms, originally present on the leaves, commence fermentation. Yeasts attack the sugars, exhaust the oxygen and produce small amounts of alcohol. Bacteria change sugars into various organic acids, chief among which is lactic acid. During fermentation, a scum or foam collects on the surface and this should be skimmed off from time to time. If not removed, the scum will destroy the acids underneath.

Storage — When fermentation is complete, the sauerkraut should be stored in a cool place where it will keep, providing it is kept free from contamination by sealing or covering. A better method of storing the sauerkraut is to pack the kraut in sterilized glass jars and fill with the original brine or, instead, use a weak brine made by adding an ounce of salt to each quart of water to completely fill the jar. The jars should be sealed tightly and stored in a cool place.

UNDESIRABLE FERMENTATIONS

1. Pink Kraut — Properly fermented kraut is firm and light in colour. Quite often a pink kraut will develop. This is caused by a certain type of yeast that develops in concentrations of salt of 3% or more. High temperatures also assist in the production of pink sauerkraut.

2. Slimy Kraut — This type of sauerkraut usually is white in colour, slimy and may be tough in texture. It is caused by either too low concentrations of salt or rapid fermentation in too warm temperatures.

3. Surface Spoilage — The scum that forms on the surface during or after fermentation is caused by organisms that destroy the desirable organic acids. Consequently, if the scum is not removed during fermentation, or if the kraut is not properly sealed after fermentation, spoilage may be found extending several inches into the product.

BACTERIAL DISEASES OF PLANTS

Certain species of bacteria are capable of producing disease in plants. Many of these diseases cause small loss, but others may be severe enough to affect the major part of a crop. Under certain conditions, light infection may develop into epidemic proportions; therefore it is essential that farmers, fruit growers and gardeners should know how and why plants are attacked and be able to control such diseases when they appear.

Bacteria causing plant diseases may be found in various places, such as in the soil, manure and crop refuse. They are found in water and on frames, boxes, tools, etc. They winter over and are protected in soil, in old cankers, dead materials, dried fruit and vegetables; in and on seeds, nursery stock, twigs and leaves. Where a disease has been severe, the bacteria are found in great numbers on the ground and on anything that has come in contact with the diseased plants.

SPREAD OF DISEASE BACTERIA

Wind is a factor in spreading dust, organic matter and refuse containing disease bacteria. Rains and dews carry bacteria from one part of a plant to

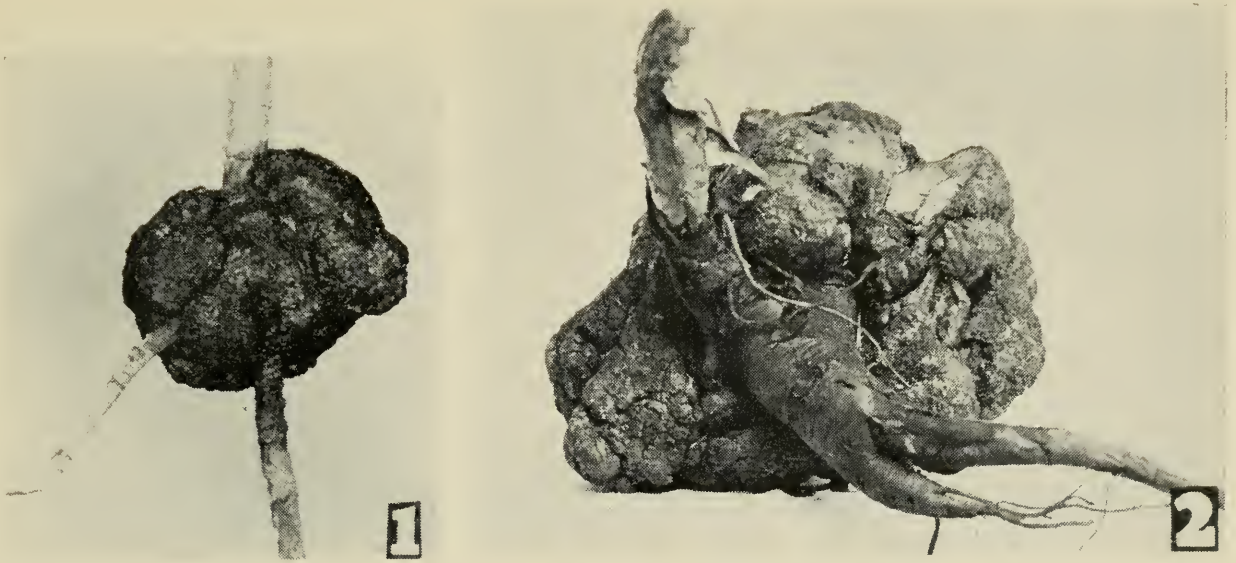


Fig. 18. Crown gall of plants. (1) Gall on young peach tree.
(2) Gall on rhubarb. (W.H.B., D.H.J.)

another. Movements of water in the soil may be the means of spreading plant disease bacteria. Insects spread countless numbers of bacteria, either carrying them on their feet and mouth parts or in their digestive tract. Many species are carried either in or on seed. Man and his equipment and tools transport bacteria from place to place. Diseased plant refuse, either fed to animals, or discarded on the manure or compost heap, means widespread contamination of the soil when such manure is distributed on the land.

METHOD OF ATTACK

Bacteria gain entrance into plants through the natural pore openings of leaves and stems. They also gain entrance through wounds brought about by bruising, cutting of roots and stems by ploughing, cultivating, pruning, etc., or through punctures made by insects. They may gain entrance into plants from infected seed. Once inside the plant they rapidly multiply in the spaces between the cells or in the veins and eventually cause various types of symptoms.

TYPES OF DISEASES

Bacteria act on plants in different ways, with the result that various types of symptoms are produced. Consequently, bacterial diseases of plants are divided into several groups, which are as follows:

Bacterial Blights—The plants attacked in this group usually are those having a shrubby, tree-like nature, such as pears, apples, quinces, walnuts, lilacs, etc. The bacteria gain entrance into the cambium layer, or inner bark, and work down this channel, forcing their way between the cells at the rate of several inches per day. The main symptoms are discoloured bark, dead tissue, clinging, mummified fruit, cankers and shrivelled leaves. Not all portions of the plant or tree may be affected and, providing diseased parts are cut 12 to 15 inches ahead of the affected areas, the rest may be saved.



Fig. 19. Fireblight of pears. (1) Young pear tree killed by fireblight which girdled the trunk about 18 inches above ground level. (2) Close-up view of the fireblight canker which killed the tree shown in No. 1. The canker developed around a small hole in the bark made by a contaminated shot-hole bark-boring beetle. (D.H.J.)

Bacterial Rots — Bacteria causing rots attack fleshy plants such as carrots, cabbages, rhubarb, iris and others. They attack the storage tissues of the plants, dissolving the layers between the cells and causing complete collapse of the tissues. The symptoms are rotting, with considerable ooze accompanied by evil odours. Rots may be of various colours, and may be soft or hard, depending upon the nature of the plant.

Bacterial Wilts — The plants affected are the same as those in which rots are produced. The bacteria, however, gain entrance into the veins or vascular system, where they rapidly multiply and choke the veins, cutting off the food supply. This results in blanching and softening of the tissues, general wilting and death. A plant attacked by a wilt organism also is susceptible to attack by secondary types of micro-organisms which may cause rotting of the plant.

Bacterial Leaf Spots — Bacteria gain entrance through pore openings or



Fig. 20. Bacterial soft rot of vegetables. Various stages of rot in celery and turnips. (D.H.J.)

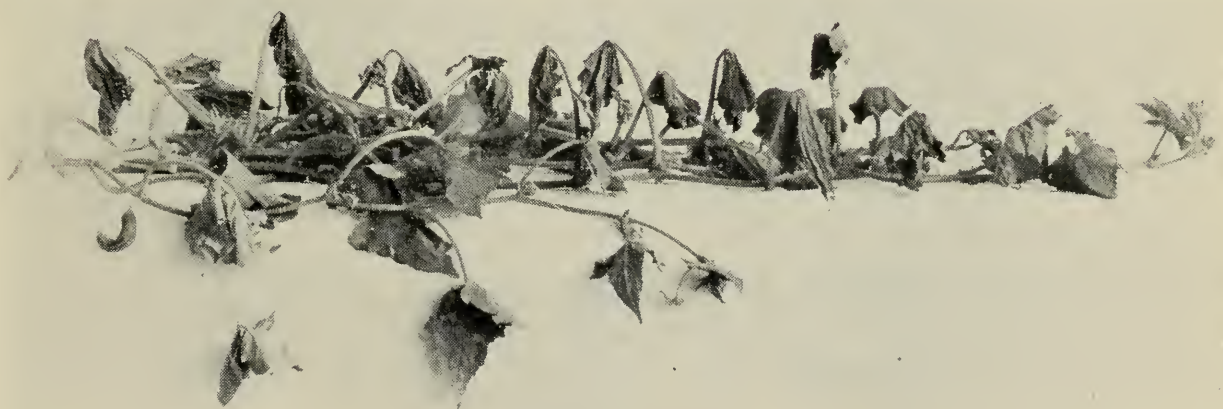


Fig. 21. Bacterial wilt of cucumbers. (D.H.J.)

insect punctures, where they feed on the storage layers of the leaf. The presence of the rapidly multiplying bacteria causes swelling at the infected point, with the result that the spot is ruptured and a typical lesion or leaf spot is produced. The centre may drop out, causing a shot-hole appearance. The spots may be so numerous that the major part of a leaf is affected, causing ragged, deformed areas, shrivelling or defoliation.

Bacterial Galls (Crown Gall) — Certain bacteria, gaining entrance into injured root hairs, or cut surfaces of most plants, stimulate the production of swellings or galls around the surface of infection. These galls may be soft or hard, depending upon the nature of the host plant. The galls may be few or numerous, small or large and are found on many plants, chief among which are raspberry, peach, apple, rose, rhubarb and daisy plants. The galls are composed of living, abnormal tissue; therefore they require nourishment, with the result that the rest of the plant suffers from starvation. The general symptoms are stunting and dwarfing, yellowing of leaves, unthriftiness and, in time, the death of the plant.

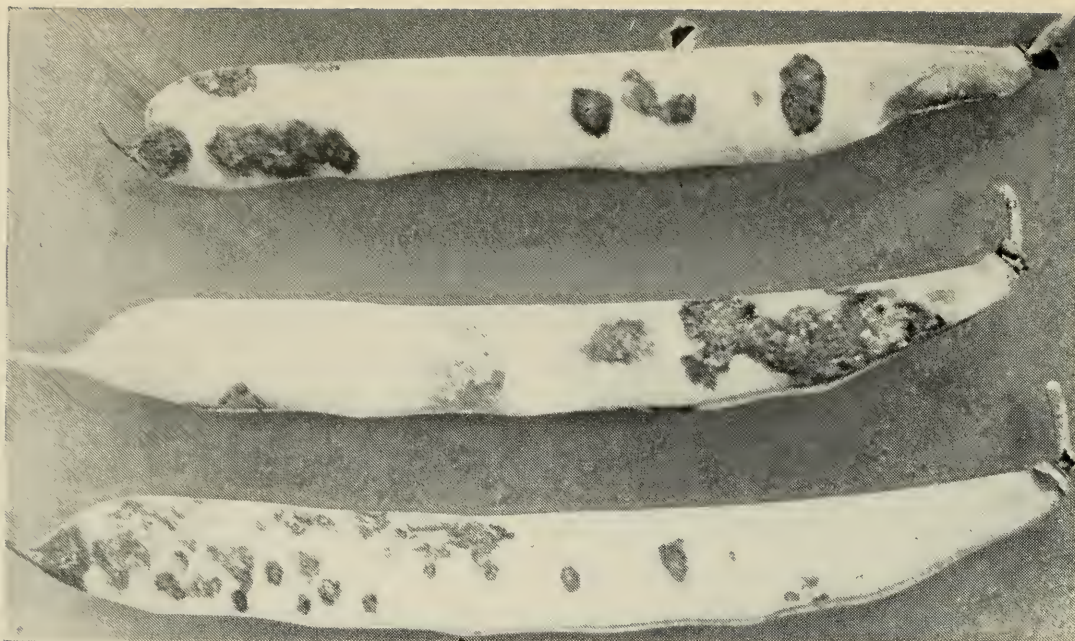


Fig. 22. Bacterial blight of beans. (D.H.J.)

CONTROL MEASURES

Descriptions of individual bacterial diseases of plants belonging to the above groups may be found in various bulletins and texts.* Although specific control measures are advocated for each disease, certain general control measures apply to all bacterial diseases of plants.

As plants generally become affected before the disease is noticed, and as it is difficult to completely check bacterial diseases once they appear, control measures are based on "prevention rather than cure":

1. Where possible, grow disease-resistant varieties.
2. Sanitary measures must be adopted.
3. Use seed treatment where advised.
4. Intermediate or alternate host plants harbouring disease bacteria should be eradicated.
5. Bacteria-carrying insects should be eliminated.
6. Sprays and fungicides should be used when they are effective.
7. All infected plants in greenhouse or field should be pulled up and destroyed.
8. All infected leaves, fruits, vegetables and other crop refuse should be removed from greenhouse or field and burned or buried deeply.
9. Correct cultural treatment builds strong plants, more resistant to disease.
10. Where a disease has been present in a crop, neither that crop nor other susceptible plants should be planted or sown on the same ground for 3 to 5 years.
11. Good under-drainage is important.

*Ontario Department of Agriculture Bulletin 386.

12. Care must be taken not to wound or injure plants during hoeing, cultivating or other operations.
13. Diseased plants, fruits or vegetables should not be placed in storage.

MICRO-ORGANISMS AND FOODS

Foods not properly preserved will spoil; such spoilage is brought about by bacteria, moulds and yeasts. Yeasts spoil sweet foods by fermentation; acid foods are subject to attack by moulds, and bacteria cause spoilage of most food products. Depending upon the nature of the foodstuff, it is not necessary that all micro-organisms be destroyed, but those especially significant must be controlled or eliminated.

Any food product exposed to the atmosphere becomes contaminated with various types of micro-organisms. If conditions are suitable, they will rapidly multiply and spoil the product by decay or fermentation. In addition to original contamination from soil, dust, air, etc., many undesirable bacteria may be added by handling, from flies, instruments, storage containers, processing equipment and other sources. In order to prevent this contamination it is essential that strict sanitary and hygienic conditions should prevail. The fewer the number of micro-organisms on foods, the easier they are preserved; hence the need for inspection of meats, milk and other products.

The spoilage of food is dependent upon certain conditions; among these are warmth and moisture. Foods maintained in a warm atmosphere can spoil rapidly but, if kept under cold conditions, spoilage may be very slow or arrested altogether. The same is true of moisture; the lower the water content of foods, the more resistant they are to the action of micro-organisms. Before spoilage can occur, foods must have approximately 12% moisture. In view of these conditions foods are preserved mainly by desiccation, refrigeration and by heat.

DESICCATION

Desiccation or drying is the oldest known method of preserving foods. Many foods are preserved by nature in this fashion, including nuts, grains and seeds. These and such products as flour, meals, sugar, uncooked cereal preparations, etc., contain insufficient moisture for the development of micro-organisms, and they will remain preserved indefinitely until exposed to moisture.

Dehydration or drying of vegetables, meats, fish, milk, eggs and other products is becoming a major industry. Such dried foods can be shipped long distances at all seasons of the year. Also, by drying it is possible to considerably reduce their weight and volume. The water content must be kept below 10% to ensure their continued preservation.

With dried fruits, honey, syrups, etc., the water content need not be reduced to the same extent as in cereals, powdered milk and others. This is because of the high percentage of sugar present; when sufficiently concentrated, the sugar prevents the action of moulds and yeasts. If dried fruits, however, are allowed to become damp, they absorb moisture, the sugar is diluted, and fermentation by yeasts, or mouldiness by moulds takes place.

Only in certain instances are bacteria, moulds and yeasts killed during the drying or dehydrating process. Therefore, dried foods are not free from such micro-organisms; they may contain many types of bacteria, moulds or yeasts

that remain inactive until the water content is restored. Rapid spoilage will result after water is added unless the product is immediately cooked or baked. A good example of a spoiled desiccated product is fermented grain that has been stored in a damp condition.

REFRIGERATION

Since ancient times it has been known that low temperatures preserve foods, but it is only within comparatively recent years that the principles of refrigeration are being understood and applied. In modern refrigeration, foods either are maintained at cold storage temperatures or are completely frozen.

Cold Storage — By cold storage is meant the holding of foods at temperatures above freezing. Whereas many methods have been used, the modern electric refrigerator has been universally adopted where power is available. Few bacteria are killed at temperatures above freezing, but their activities are arrested. Foods eventually will spoil at temperatures above freezing, but in household practice food is not held for periods long enough to allow appreciable spoilage to occur.

Freezing — By freezing, the water in foods is frozen and therefore is not available to micro-organisms. Such frozen food resists the action of bacteria until it is thawed. In this manner, meats, fish, poultry and other products may be preserved for long periods of time. By "fast freezing" it is possible to freeze foods with minimum damage to tissues; the ice crystals are smaller and the food remains in a better physical condition.

Frozen foods are not sterile; as mentioned previously, most foods are contaminated from various sources, and quite high counts of bacteria may be found on certain products. While many of these bacteria may be killed by freezing, others are not, with the result that, while they are harmless in the frozen state, they can rapidly spoil food when more suitable temperatures are restored.

When frozen foods are thawed, the bacteria present may develop very rapidly and cause spoilage. Frozen foods spoil more rapidly after thawing than foods which have not been frozen. Certain changes brought about during the freezing process allow more rapid bacterial action when higher temperatures are reached. Frozen foods therefore should be cooked or consumed as soon as possible after thawing.

HEAT

Various high temperatures are employed to bring about the destruction of micro-organisms in food, and it depends upon the nature of the product and the types of micro-organisms to be controlled as to which shall be used.

Pasteurization — By pasteurization is meant the heating of certain food products to temperatures below the boiling point in order to kill certain types of micro-organisms. The temperature may vary from 140° to 160° F., depending upon the product. Milk is pasteurized to destroy disease bacteria; wines, beers, fruit juices, vinegar, etc., are pasteurized to eliminate certain undesirable micro-organisms that might cause abnormal fermentations or spoilage. Pasteurization does not sterilize the product but may greatly reduce the number of organisms.

Boiling — Boiling at 212° F. is used for the preparation of foods for immediate consumption and preservation of fruits. While boiling temperature will kill moulds, yeasts and bacteria in the vegetative state, even prolonged boiling may not kill bacterial spores. Fruits can be preserved by boiling because the moulds and yeasts are killed, and the acid or sugar content prevents bacterial action. Processing in boiling water is unsafe for non-acid vegetables and meats, as they require higher temperatures.

CANNING

By canning is meant the sterilization of foods in sealed containers. This is accomplished by employing pressure cookers, autoclaves or retorts where steam is subjected to pressure, and temperatures considerably higher than 212° F. are attained. Various times and temperatures are used for different food products. By this method resistant bacterial spores are destroyed.

In home canning, vegetables and meats should be processed only in correctly operated pressure cookers; by so doing food poisoning and spoilage will be avoided.

Whatever method is used, it is possible to keep down the numbers of micro-organisms by using thoroughly washed and clean food products and adopting strict sanitary precautions. The freer the food from bacterial life, the easier it is to preserve.

Details of canning and preserving foodstuffs may be obtained from various Provincial and Dominion Bulletins.

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Salads

- ALL THE YEAR 'ROUND



ONTARIO DEPARTMENT of AGRICULTURE

STATISTICS AND PUBLICATIONS BRANCH, TORONTO, ONTARIO

BULLETIN 466

APRIL, 1949

Salads

- ALL THE YEAR 'ROUND

THE OBJECTIVE OF "SALADS ALL
THE YEAR 'ROUND" IS TO PROVE
TO YOU AND YOUR FAMILY THAT
SALADS ARE FULL OF ZIP AND
MAY BEGIN . . . ACCOMPANY . . .
END . . . OR MAKE A MEAL! SERVE
GOOD SALADS IN ALL SEASONS!
WHEN SHOULD YOU START?
TODAY!

Prepared by

**Women's Institute Branch
and
Home Economics Service**

ONTARIO DEPARTMENT of AGRICULTURE

Rabbit Food?...

Seems to be the familiar murmur from the menfolk when a salad is on the menu. Agreed?

The recipes in this book are designed to make the men in your life praise your salads as loudly as your apple pie.

Make every day a salad day at your house!



Seasonings

to enliven flavour

Onion or onion salt	Bay leaf
Garlic or garlic salt	Cloves
Celery salt	Freshly ground nutmeg
Mustard seed	Lemon rind
Horseradish	Lemon juice
Leeks	Chopped pickles
Chili powder	Worcestershire sauce
Curry powder	Tabasco sauce
Freshly ground pepper	Mint

MEASUREMENTS

ABBREVIATIONS

Cup.....	c.
Tablespoon.....	tblsp.
Teaspoon.....	tsp.
Few Grains.....	f.g.

EQUIVALENTS

1 c.....	8 oz.
16 tblsp.....	1 c.
3 tsp.....	1 tblsp.

IMPORTANT

- ★ *Selecting* ➡
- ★ *Preparing* ➡
- ★ *Chilling* ➡
- ★ *Cutting* ➡
- ★ *Adding Dressing* ➡
- ★ *Tossing* ➡
- ★ *Tasting* ➡
- ★ *Arranging* ➡
- ★ *Serving* ➡

How Do Your Salads Rate?

A GOOD SALAD IS...

COLD...

CRISP...

COLOURFUL

PRETTY AS A PICTURE

PILED LIGHTLY IN A BOWL OR ON A PLATE

TASTY...FIT FOR A KING!



POINTS IN SALAD MAKING

Choose only "garden fresh" fruits and vegetables in quantities for immediate use. In the summer, a home garden is a great boon to the homemaker who appreciates the value of "garden freshness".

As soon as salad greens arrive in your kitchen, remove damaged leaves, rinse in cold water and drain. Store in the covered crisper of your refrigerator or in a covered container in a cold place. To separate leaves from a head of lettuce, first cut out the centre core. Run a stream of cold water from the tap into this depression or let lettuce stand for a few minutes in very cold water. Remove moisture from separated leaves by shaking in clean tea towel before use.

All ingredients, including the dressing, should be chilled before the salad is prepared. It is ideal to chill even the mixing bowl and serving bowl or plates.

Salad materials should be cut in uniform well-defined pieces, large enough to prevent loss of shape in tossing. Thoroughly drain liquid from salad ingredients. Plan to prepare fresh fruits and vegetables for salads the last minute before serving.

Except where recipe indicates otherwise, add dressing just before serving. Avoid using too much dressing. Your salad should not be too moist.

Combine the materials by tossing. Toss just before serving with a spoon and fork and avoid crushing and overmixing.

Taste before serving. Judge the flavour critically. Salads with indifferent flavour are often enlivened by judicious seasoning. Remember that there are many seasonings other than salt.

Arrangement is important for eye appeal. Pile your salad mixture high and lightly. Use all your artistic talents in salad arrangement. Remember that attractive colour contrasts play a big part in "eye appeal". Garnish with style. See page 14.

In a family-sized bowl or in individual servings, salads can steal the show at meal time. Serve as the main course at supper; in place of cooked vegetables or in addition to cooked vegetables at dinner. Serve immediately after arranging.

Surprise Flavour with ... Salad Dressings



Cooked Salad Dressing

"Satin smooth with matching flavour elegance"

- 1 tsp. mustard
- 1½ tsp. salt
- 2 tbsps. sugar
- 2 tbsps. flour
- 2 egg yolks or
1 egg beaten
- 1 c. milk
- 2 tbsps. butter
- ⅓ c. vinegar

1. Mix dry ingredients in top of double boiler.
2. Slowly add beaten egg and milk. Stir.
3. Cook over boiling water. Stir until thick.
4. Add butter.
5. Cool slightly; add vinegar slowly.
6. After chilling, store in covered jar in cold place.

Cooked Mayonnaise

"Mmm—here's a mayonnaise that's just right—"

- (1)
- 1½ tsp. mustard
 - 1 tsp. salt
 - 2 tbsps. corn
syrup or sugar
 - 1 egg
 - ½ c. oil
 - ½ c. vinegar

- (2)
- ¼ c. flour
 - ¼ c. cold water
 - ¾ c. hot water

1. Measure (1) into a large bowl. Stir slightly.
2. Make paste of cold water and flour. Add hot water slowly. Cook and stir until clear.
3. Pour (2) over first mixture.
4. Beat with Dover beater until mayonnaise begins to thicken.
5. After chilling, store in covered jar in cold place.

Tomato French Dressing

*"Oil, sly seasonings and tomato
pull the family vote"*

- ½ tsp. mustard
- 1 tsp. salt
- ¼ tsp. pepper
- ½ tsp. paprika
- ½ c. vinegar
- ½ c. oil
- ⅓ c. tomato soup
(optional)

1. Blend dry ingredients in sauce pan.
2. Add vinegar and oil.
3. Boil 1 minute.
4. Beat with Dover beater to combine.
5. Add tomato soup. Beat.
6. After chilling, store in covered bottle in cold place.
7. Shake well before using.

Sour Cream Dressing

"Sour cream and pickles—tantalizing"

- 1 c. thick sour cream
- 2 tbsp. vinegar
- $\frac{1}{2}$ tsp. salt
- f.g. paprika
- 2 tbsp. sugar
- $\frac{1}{2}$ c. drained and chopped sweet pickles

1. Combine ingredients.
2. Store in covered bottle in cold place.

Whipped Cream Dressing

"Mmmmm—Need we say more?"

- 2 tbsp. sugar
- 1 tsp. salt
- 2 tbsp. flour
- 1 tsp. mustard
- f.g. cayenne
- 2 egg yolks
- $\frac{3}{4}$ c. milk
- $\frac{1}{4}$ c. vinegar
- 1 tsp. butter
- $\frac{3}{4}$ c. heavy cream whipped

1. Mix dry ingredients in top of double boiler
2. Slowly add slightly beaten egg yolks and milk. Stir.
3. Cook over boiling water until thick. Stir constantly.
4. Add vinegar and butter.
5. Mix well and chill.
6. Add whipped cream immediately before serving.

Fruit Dressing

"Light and airy, with old-time lemon tang and orange tingle"

- 2 tbsp. flour
- 2 tbsp. sugar
- $\frac{1}{2}$ tsp. salt
- $\frac{1}{3}$ c. marmalade
- 1 c. water
- 1 tsp. grated orange rind
- 2 eggs
- 2 tbsp. lemon juice
- 2 tbsp. orange juice

1. Mix dry ingredients in top of double boiler.
2. Mix marmalade, water and orange rind.
3. Slowly add wet ingredients to dry ingredients. Cook and stir over direct heat until thick.
4. Add to beaten eggs. Cook 5 minutes longer over boiling water.
5. Remove from heat. Add fruit juices.
6. After chilling, store in covered bottle in a cold place.

Peanut Butter Dressing

"Peanut butter lovers will cheer this—"

- 2 tbsp. peanut butter
- $\frac{1}{2}$ c. lemon juice
- 1 tbsp. sugar
- $\frac{1}{2}$ tsp. salt

1. Combine. Beat until smooth.

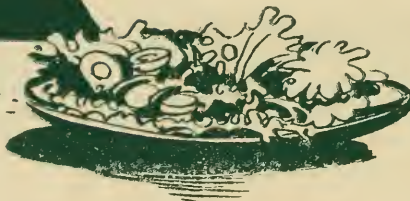
Sweetened Vinegar

- $\frac{1}{4}$ c. brown sugar
- $\frac{1}{4}$ c. vinegar
- $\frac{1}{4}$ c. water
- $\frac{1}{4}$ tsp. salt

1. Stir until sugar and salt dissolve.
2. Bottle.

Salad Greens

LETTUCE—LEAF OR HEAD
GREEN CABBAGE
ENDIVE
CRESS
PEPPER GRASS
CHINESE CABBAGE
PARSLEY
SPINACH



Tossed Salad Greens

This salad consists mainly of coarsely torn head or leaf lettuce to which one or more of such vegetables as the following are added:

shredded spinach
finely chopped onion
sliced radishes
finely chopped green pepper
endive
bean sprouts

fine carrot sticks
diced cucumber
diced tomatoes
cress
pepper grass
finely shredded green or red cabbage

Every man for himself in seasoning and dressing, but French dressing is the popular choice.

Garden Salad

"Tops on the Salad Parade the Year Round"

2 c. lettuce—torn
½ c. celery tops—chopped
½ c. diced celery
1 medium onion diced
½ c. grated raw carrot
½ c. tomato—chopped
½ c. grated raw parsnip
½ c. grated raw turnip
¼ c. grated raw beet
½ c. French dressing, lemon juice
or sweetened vinegar

1. Prepare vegetables immediately before serving.
2. Add dressing. Toss slightly.
3. Serve in attractive bowl.



Health Cabbage Salad

"That's right — just packed full of vitamins for vim, vigour and vitality"

- 1/4 c. cooked salad dressing
- 1 tbsp. lemon juice
- 1 c. shredded cabbage
- 1/2 c. grated raw carrot
- 1/4 c. raisins
- 1/4 c. peanuts (chopped)
- 1 c. diced apple

1. Combine salad dressing and lemon juice.
2. Toss ingredients lightly, just before serving.

Beet and Celery Salad

"Cool, crisp and colourful, all in a jiffy"

- 1 tsp. sugar
- 1/3 c. French dressing
- 2 c. diced cooked beets
- 1/2 c. diced celery
- 1/2 c. diced cucumber (skin left on)
- 2 tbsp. minced pickle
- 2 tbsp. chopped onion
- salt

1. Mix sugar with French dressing.
2. Combine all ingredients and chill about 1/2 hour.
3. Taste and add salt if desired.
4. Serve on greens, garnished with cucumber.

Cabbage and Bologna Salad

"Satisfies the meat man — yet chock full of crisp, garden loot"

- 2 c. shredded cabbage
- 1 c. coarsely diced bologna, weiners or other cooked meat
- 2 tbsp. chopped onion
- 1/2 c. grated raw carrot; sour cream dressing to moisten; seasoning.

1. Combine ingredients lightly just before serving.
2. Taste and add salt, if desired.

Carrot Salad

"Popular carrot and raisin with a nutty touch"

- 2 c. grated raw carrot
- 1 c. diced celery
- 1/2 c. raisins
- 1/4 c. peanuts, chopped
- 1/2 c. salad dressing

1. Combine ingredients lightly just before serving



Spanish Salad

"Crisp green pepper and celery seed add that delicious difference"

- 2 c. tomatoes—quartered and diced coarsely
- ½ c. chopped onion
- ½ c. diced green pepper
- ½ c. French dressing
- 1 tsp. celery seed

1. Combine.
2. Chill to blend flavours.

Tomato and Rice Salad

"Hearty appetite — here's a hearty salad"

- 6 tomatoes
- 1 c. cooked rice, macaroni or spaghetti
- 1 c. diced green celery
- 2 tbsp. chopped onion
- mayonnaise to moisten
- salt and pepper to taste

1. Cut tops off tomatoes. Hollow carefully.
2. Use pulp to combine with rest of filling.
3. Heap in tomatoes.

Gala Tomato Jelly

"Red as an old-fashioned fire cracker and just as zippy"

- 2 tbsp. gelatine
- ⅓ c. cold water
- 2½ c. tomato juice
- ½ bay leaf
- 1 slice onion
- ⅓ tsp. celery salt
- 4 cloves
- 1½ tsp. salt
- 2 tbsp. lemon juice (if desired)

1. Soften gelatine in cold water.
2. Simmer the next six ingredients, covered, 20 minutes. Strain.
3. Pour over softened gelatine; stir until gelatine is dissolved. Add lemon juice.
4. Pour into moistened moulds. Chill and unmould on lettuce.
5. When mixture is partially set, chopped parsley, hard cooked eggs, peas, diced celery or sliced stuffed olives may be added.

Macedoine Salad

"Leftovers can be used to advantage"

- 1 c. cooked diced carrots
- 1/2 c. peas (cooked)
- 1/2 c. green beans (cooked)
- 1/2 c. diced celery
- 2 tbsp. chopped onion
- 1/2 c. French dressing, mayonnaise or boiled dressing
- salt and pepper to taste
- 2 eggs, hard cooked

1. Mix lightly.
2. Garnish with hard cooked egg.

Jellied Vegetable Salad

"They're festive, shimmering and easy to make"

BASE

- 1 tbsp. gelatine
- 1/2 c. cold water
- 1 c. vegetable water
- 1 tsp. salt
- 2 tbsp. sugar
- 1/4 c. vinegar
- 2 c. vegetables

1. Soak gelatine in cold water.
2. Add salt and sugar to vegetable water. Heat to boil.
3. Dissolve soaked gelatine in vegetable water.
4. Add vinegar.
5. Cool. When gelatine begins to thicken add vegetables. See suggested vegetable combinations.
6. Set in moistened moulds.

SUGGESTED VEGETABLE COMBINATIONS

- 1 c. shredded cabbage
- 1/2 c. peas
- 1/2 c. cooked carrots, diced
- 2 tbsp. diced pickles

or

- 1 c. shredded cabbage
- 1/2 c. cooked carrots, diced
- 1/2 c. celery, diced

Hot Potato Salad

Some like it

hot!

- 3/4 c. diced salt pork or bacon
- 1/4 c. chopped onion
- 4 c. diced cooked potatoes
- 1/4 c. vinegar mixed with 1/4 c. water
- 2 tsp. salt
- 1/2 tsp. celery salt

1. Fry pork until nearly crisp, add onions and cook until onions are lightly browned.
2. Lift pork and onions from fat. Place in top of double boiler.
3. Add potatoes.
4. Add vinegar.
5. Season.
6. Cook over boiling water. Stir occasionally with fork. Serve hot.

Potato Salad

Some like it

cold!

- 2 c. diced cooked potatoes
- 1 c. diced celery
- 1/4 c. finely chopped onion
- 1/4 c. chopped pickle
- 1/2 c. salad dressing
- 1 tsp. salt
- 1/4 tsp. pepper
- 1/8 tsp. curry powder

1. Toss lightly together.
2. Chill and allow to stand an hour before serving.
3. Taste. Add additional seasoning if desired.

CHICKEN DELIGHT

*"Luscious
Chicken Bits
Bubble Under
Golden
Mayonnaise"*

2 c. diced chicken
1 c. diced celery
2 tbsp. chopped green pepper
1 tbsp. chopped red pepper
mayonnaise to moisten
salt and pepper to taste
Combine ingredients.



A New Angle!

JELLIED FISH SALAD

1 tbsp. gelatine
1/4 c. cold water
2 c. flaked fish
(salmon, cod, halibut)
2 tbsp. chopped pickle
2 tbsp. chopped celery tops
1/2 c. diced celery
1/2 tsp. salt
f.g. cayenne
1 c. mayonnaise

1. Soak gelatine in cold water for 5 minutes. Dissolve over boiling water.
2. Flake fish. Add rest of ingredients.
3. Mix all together, mould and chill.
4. Serve on greens. Garnish.



Baked Bean Salad

"Baked bean lovers will cheer this"

2 c. baked beans
1 c. diced celery
2 tbsp. finely diced onion
1 tbsp. finely diced red pepper
2 tbsp. finely diced green pepper
tomato French dressing
salt

1. Combine lightly.
2. Taste.
3. Season.



Baked Bean Vegetable Salad

"It's a jiffy toss up for an all-in-one lunch"

1½ c. baked beans

1 c. shredded cabbage

½ c. grated raw carrot

1 tbsp. finely diced onion

2 tbsp. finely diced green pepper

tomato French dressing

salt and pepper

1. Combine lightly.

2. Taste.

3. Season.

Cottage Cheese

"Easy to make and uses up sour milk"

1 qt. thick sour milk
(makes ⅓ lb. cheese)

salt

1. Heat milk in double boiler until lukewarm and curds and whey have separated.

2. Drain through double thickness of moistened cheese cloth.

3. Season.

Cottage Cheese Salad

"Make a real hit with cheese fans"

1 c. cottage cheese

¼ c. salad dressing

1 tsp. salt

1 tbsp. chopped parsley

¼ c. chopped celery

1. Mix lightly.

2. Serve on greens or in hollowed out tomatoes.

Stuffed Eggs

"Popular hard-cooked eggs with a meaty touch"

6 hard-cooked eggs

1 c. left over meat or fish

¼ c. chopped celery

1 tsp. salt

mayonnaise to moisten

1. Cook eggs, peel, cool and halve.

2. Finely chop meat or fish and celery. Add egg yolks and other ingredients.

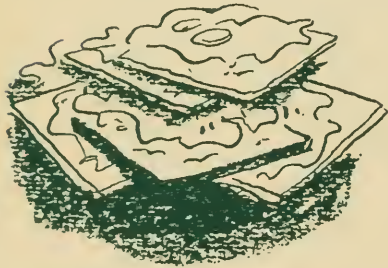
3. Heap filling in whites.

Salad Accompaniments



Soufflé Crackers

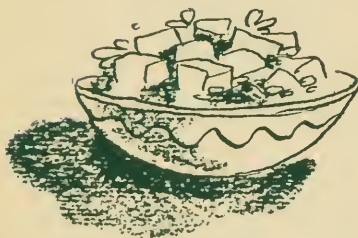
1. Cover round soda crackers with water.
2. Allow to soak until double in bulk.
3. Lift out with spatula to greased baking sheet.
4. Dot with small pieces of butter.
5. Place in hot oven and allow to brown.



Crackers

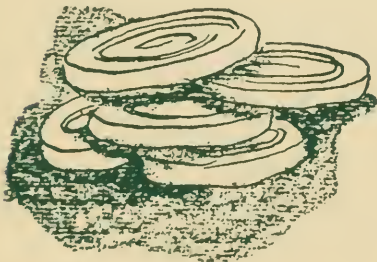
spread with cheese garnished with some of the following:

olives, pickles, pimienta, red or green peppers, white or green celery, parsley, mint, small celery leaves, chopped onion tops or chives.



Cheese Croûtons

1. Cut bread into $\frac{1}{2}$ inch slices.
2. Trim off crusts and cut into cubes.
3. Brush all surfaces with melted butter.
4. Roll in grated cheese.
5. Place cubes on baking sheet and brown in moderate oven.



Bologna Rolls

1. Spread bologna with soft cheese.
2. Roll up like jelly roll.
3. Allow to stand in cold place until set.
4. Slice off like jelly roll.



Rolled Sandwiches

1. Remove crusts from a loaf of fresh bread.
2. Cut lengthwise in thin slices, buttering before cutting.
3. Place on a damp towel, spread with any paste filling. Roll from small end like jelly roll.
4. Pickles or stuffed olives may be placed across the bread before rolling.
5. Wrap in a damp towel and when ready to serve, slice as a jelly roll.

Fruit Salads

Ambrosia Salad

"Sweet and tart fresh fruit, snowy whipped cream—a super salad"

¼ c. fruit dressing mixed with

½ c. whipped cream

¾ c. sectioned orange

¾ c. sectioned grapefruit

¼ c. dates or raisins

½ c. diced apple

1 banana (diced)

1. Mix fruit dressing with whipped cream.

2. Toss fruit lightly together just before serving.

3. Combine fruit and dressing immediately.

Jellied Fruit Salad

"Light and cool for hearty meat-and-potato dinners"

1 tbsp. gelatine

¼ c. cold water

⅓ c. jelly or marmalade

⅔ c. boiling water

2 tbsp. sugar

½ tsp. salt

¼ c. lemon juice

¼ c. orange juice

2 c. diced fruit

1. Soak gelatine in cold water 5 minutes.

2. Mix marmalade, boiling water, sugar and salt and add to soaked gelatine.

3. Stir until all gelatine dissolves.

4. Add juices.

5. When gelatine thickens add fruit.

6. Set in moistened moulds.

Note: Only cooked pineapple should be used in gelatine mixtures

Waldorf Salad

"Use imagination to vary an old favourite"

1 c. celery, finely diced

½ c. nuts, chopped (optional)

1 c. apple, diced

salad dressing or
mayonnaise or fruit or
whipped cream dressing

1. Prepare all ingredients for salad, except apple.

2. Dice apple just before salad is to be served. Leave skin on red apple.

3. Toss all ingredients lightly with enough dressing to moisten.

Pineapple, grapes, bananas, marshmallows or dates may be added to this recipe.



Let garnishes add pleasing contrasts in colour, flavour and texture. Let your garnish give that final flourish to your work of art. Garnish with imagination! Garnish with style! One word of caution. Just as decoration on clothes should be used with restraint, so garnishes on food should be used sparingly. Here are a few suggestions for garnishing:

Sprigs of fresh parsley, mint and watercress.

Stuffed olives, (sliced or whole), pickles, pearl onions.

Pimiento, chives, rings of green and red pepper.

Coloured jelly cubes, cream or cottage cheese, candied peel or cherries.

Cheese Balls—Roll balls of soft cheese in finely chopped nuts or parsley.

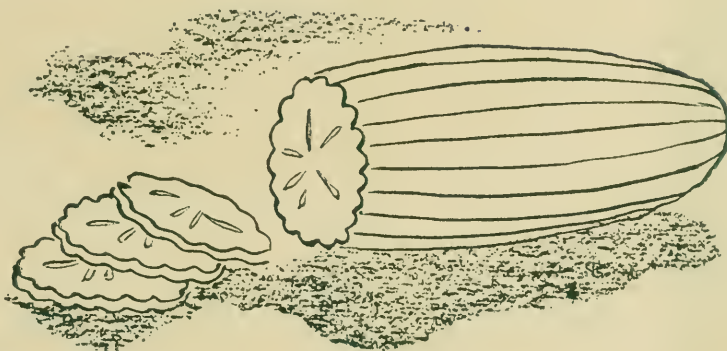
Radish Roses—Trim leaves and tip. Cut the skin in 6 or 8 sections to within one-quarter inch of the stem. Separate the skin from the centre and place in cold water to curl.

Celery Curls—Cut washed celery in three inch lengths. At both ends make 5 or 6 parallel cuts extending one-third of the length of the celery. Place in cold water for several hours and the ends will curl back.

Corn Shucks—Cut celery sticks 3 inches long. Cut to curl at both ends. Cut out rings from one-eighth inch carrot slices. Put two celery sticks together and slip carrot ring over them. Place in cold water. The celery will curl back and be held in place by the carrot ring.

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Hard-cooked Eggs—Cut eggs in slices and sprinkle with paprika.

Cucumber—Score unpeeled cucumbers lengthwise with a fork and slice thinly.



Lettuce leaves, whole or shredded.

Heads of lettuce cut into slices or wedges.

Lemon slices dipped in chopped parsley.

Twists of orange.

Cooked beets cut in various shapes; grated raw.

Carrots uncooked or cooked cut in various shapes; grated raw; curled.

Tomatoes, sliced or cut in wedges.

Mayonnaise forced through a tube. This mayonnaise may be coloured.

Paprika.

Peanut Butter or Date Balls—Roll balls of peanut butter or dates in chopped nuts.

Banana Rolls—Roll $1\frac{1}{2}$ inch lengths of banana in salad dressing and then in browned cocoanut or chopped nuts.



HELP YOURSELF TO HEALTH

HERE ARE THE FOODS FOR HEALTH

Eat them every day.

Drink plenty of water.

1. MILK—ADULTS, $\frac{1}{2}$ to 1 pint. Children, $1\frac{1}{2}$ pints to 1 quart.
2. FRUIT—One serving of citrus fruit or tomatoes or their juices; and one serving of other fruit.
3. VEGETABLES—At least one serving of potatoes; at least two servings of other vegetables, preferably leafy, green or yellow, and frequently raw.
4. CEREALS AND BREAD—One serving of a whole-grain cereal and at least four slices of Canada Approved Vitamin B bread (whole wheat, brown or white) with butter.
5. MEAT AND FISH—One serving of meat, fish, poultry or meat alternates, such as beans, peas, nuts, eggs or cheese. Also use eggs and cheese at least three times a week each and liver frequently.

A fish liver oil, as a source of vitamin D, should be given to children and expectant women, and may be advisable for other adults.

Iodized salt is recommended.



CANADA'S FOOD RULES

Approved by the

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DEPARTMENT OF AGRICULTURE

Women's Institute Branch and Home Economics Service

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FROZEN FOODS



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F R O Z E N F O O D S

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This bulletin is intended for householders who use the freezing method for the preservation of part of their food supply.

Most persons have eaten frozen meat or fish though the flesh may have been purchased in the thawed condition. Some are familiar with frozen fruits, vegetables, or bake-shop goods. But there remains much unfamiliarity with the processing of frozen foods and some confusion as to how the freezing method works.

The first section covers problems which are common to frozen foods. Succeeding sections contain discussions on the processing of fruits and vegetables, the freezing of poultry and the freezing of meats, respectively.

The authors of the various chapters will emphasize any difficulties in the freezing method of preservation in an endeavour to prevent disappointment in the quality of frozen foods and to prevent actual losses in frozen foods. The freezing method is, on the whole, a simple procedure, but, even slight deviation from well proven procedures can result in serious loss in eating quality, and carelessness or ignorance can result in inedible or even dangerous products.

SECTION I

PROBLEMS IN THE FREEZING OF FOODS

By J. H. L. TRUSCOTT

DETERIORATION IN FOOD

Most of the food we eat comes from plants or animals and most of the frozen foods discussed in this bulletin are tissues removed directly from a plant or animal. The flesh of cattle, birds, or fish stays in good condition for years—so long as it is a living part of a live creature. But from the moment of slaughter flesh begins a complicated series of changes which will result eventually in a product that is unfit for human consumption. The tissues harvested from plants differ from flesh in that they are still alive and have a variable ability to remain alive for days, weeks, or months before dying. Long before natural death, however, such tissues become unpalatable and some like green peas and asparagus may lose much quality in three or four hours after harvest. Plant tissues can be killed by much heat, little heat (freezing), by chemicals and by crushing. They then deteriorate quickly unless they are processed as canned, dehydrated, pickled, or frozen goods.

THE CAUSES OF FOOD DETERIORATION

Small plants called bacteria and molds can feed on living or dead plant tissues and on flesh. They digest part or all of the food and excrete their body wastes back into the food. The resulting soft, discoloured and often evil smelling mixture is called rot or decay.

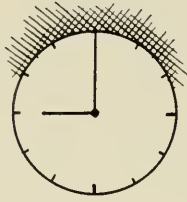
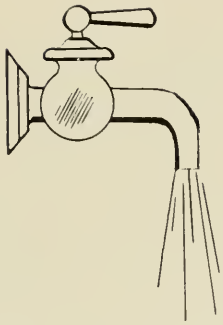
Numerous chemical agencies naturally in foods cause changes in texture, colour, flavour and food value. In a few instances the changes are desirable in moderation: for example, the tenderizing of beef by hanging or the aging of cheese. But it is not desirable for the change to go to the point of liquefying the beef or leaving nothing but mold in the cheese.

THE EFFECT OF HEAT ON THE AGENCIES OF DETERIORATION

At ordinary room temperature and to somewhat above 100° F. the bacteria and molds, the chemical agencies, and the life-changes in unprocessed fruits and vegetables, destroy foods very quickly. Fortunately all of the agencies are retarded when some heat is removed from the food. When enough heat is removed to reduce the food temperature to about 35° F. the destructive effects are relatively very slow. Further heat removal to a temperature between 25° F. and 30° F. brings about the familiar hardening of the foods when they are frozen. But there is still enough heat in the food to allow considerable chemical activity and some bacterial and mold growth. Experience has shown that the highest temperature for effective preservation of most frozen foods is 0° F. Chemical changes proceed slowly enough at that temperature so that most foods are satisfactory after 12-months storage. There is no bacterial or mold activity at 0° F. and plant tissues are killed. Less heat (lower temperature) is desirable but it becomes increasingly expensive to maintain such conditions.

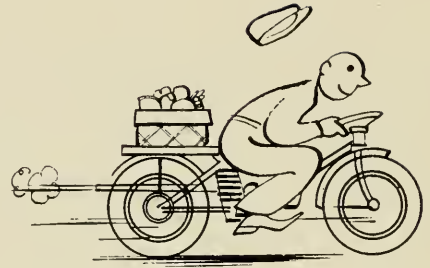
Even a temperature of 0° F. is sometimes not alone effective in preserving the eating quality of food. For instance, the preservation effect of sugar (as syrup) is usually necessary in frozen fruits, and it is necessary to heat vegetables to destroy chemical agents called enzymes before the vegetables will keep satisfactorily at 0° F.

FAST COOLING



Work fast.

Cold water helps



1. KEEP THE FOOD COOL

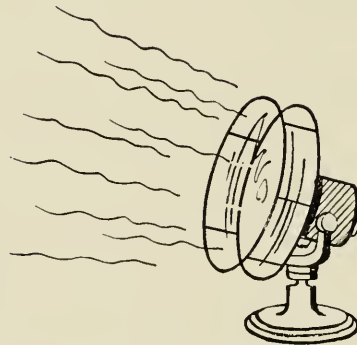
2. GET IT TO THE FREEZER FAST!



Freezing metal surfaces help.

Scatter the packages.

Small packages freeze faster.



Fans help.



0°F. or lower temps.

3. USE FREEZING AIR (0°F. or lower)

THE RATE OF HEAT REMOVAL, OR, THE RATE OF FREEZING

The principle of fast freezing has received much experimental attention during the past 25 years and it has been the subject of heated arguments. The important aspects of the problem are as follows.

Quick cooling to a point near or at the freezing point is highly necessary in all foods. The various destructive agencies are greatly slowed thereby and the food loses little quality. Large pieces of food or many small packages of food piled closely together cool so slowly that deterioration of a serious nature may occur *before* the food is frozen.

The second phase of cooling is the actual process of freezing. During this time ice crystals are forming in the food and their number and size depend on the length of time necessary to harden the whole piece of food. If the time is long there are more and larger ice crystals than if the time is short. The formation of ice crystals damages the tissues and may result in leakage of valuable juices and undesirable changes in texture when the food is thawed for use. Beef and fish especially suffer losses in quality due to slow freezing.

The third phase of cooling occurs after the tissues are hardened by freezing. Still more heat must be removed to reach a satisfactory storage temperature. As mentioned above, that temperature is generally considered to be 0° F. Lower temperatures are better but become too expensive to maintain.

HOW TO GET FAST COOLING

Anything that can be done to facilitate the movement of heat out of food is desirable. Small pieces or packages of food will cool faster than larger ones. Individual packages of food will cool more quickly than when piled together. The lowest available temperature should be used. A blast of cold air on each package will cool the food nearly twice as fast as will still air of the same temperature. Contact of the package with cold metal facilitates the removal of heat.

PACKAGING OR WRAPPING

It is true, unfortunately, that packaging foods before freezing slows the subsequent rate of cooling because of the insulating nature of the package and because a lump of food is frozen instead of individual pieces. Nevertheless, packaging is a necessity.

Obviously food must be kept clean, prevented from freezing together in huge lumps, and it must be in a package that can be carried without damage to clothing. Frozen food loses quality if it is re-frozen, so packages should be of such a size that the contents are consumed immediately. Some foods require a liquid covering. Finally, a package is necessary to reduce evaporation from the food while it is in low temperature storage. *Evaporation from frozen food results in an appearance called "freezer burn".* Initially, such dried spots mar only the appearance of the food, but as the condition advances the food can become quite useless. Water loss is a very serious problem in frozen foods.

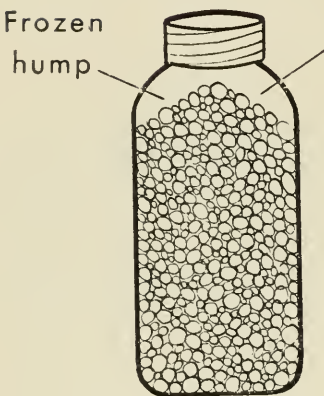
Packages now used for frozen foods include the following: metal cans, rectangular or cylindrical paper and plastic containers, glass jars, and wrapping papers which may have several layers bonded together with waxes, asphalt, plastics, transparent cellulose, rubber, or metal foils.

Metal cans are used for institutional frozen foods but we have felt that for home use there is too great a chance to confuse the frozen product with a canned product. The frozen food is not sterile and it will not keep after it is defrosted. Glass containers are usually plentiful in a home and they make good frozen food containers so far as the food is concerned. But they do not stack well in a locker or home freezer and there is some chance of breakage.

Rectangular or cylindrical waxed cardboard containers are often used. Both may need an inner bag made of rubber or cellulose film and the same film may be used as a heat sealed overwrap. Such containers and wraps are available from almost any source that sells paper and they are often available at locker plants.

A special problem exists in the packaging of large uneven objects such as whole poultry. In that instance any large air space left between the skin and the wrap will result in some freezer burn. At least one waxy or plastic material is available which is applied as a hot dip.

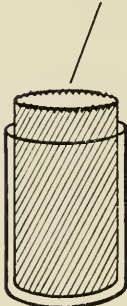
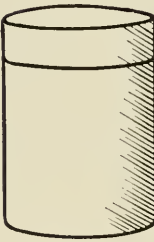
PACKAGES FOR FROZEN FOODS



Don't overfill or the neck will be broken

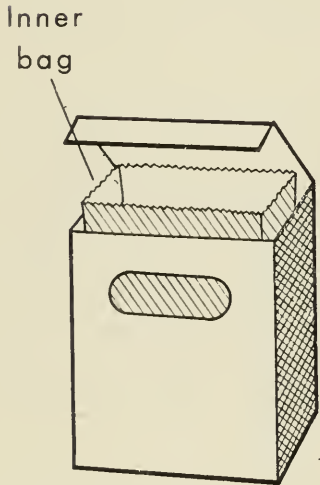


QUART OR PINT
MASON JAR

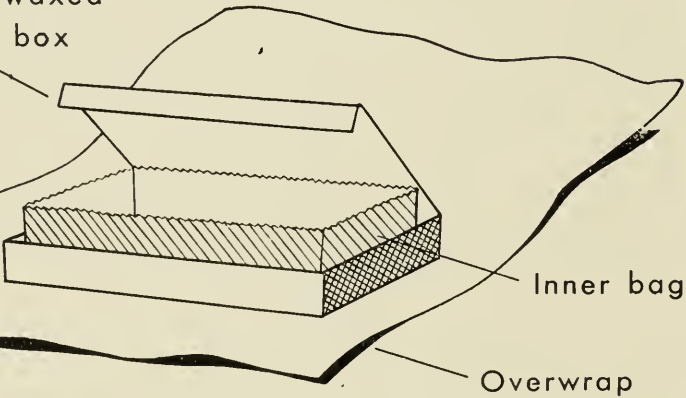


An inner bag is a good thing

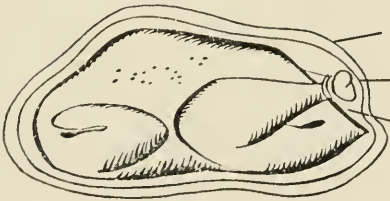
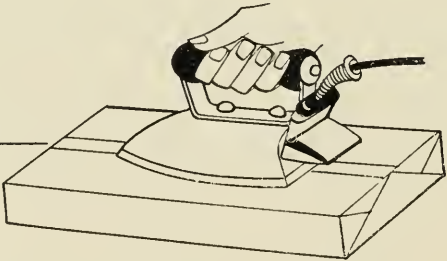
WAXED CARDBOARD
CYLINDRICAL SHAPE



Rectangular waxed cardboard box



Heat sealed joints



Strong moisture resistant paper

Film-type wrap — or foil

Make a tight fit

THE LOCKER PLANT

One of the modern facilities available for the freezing preservation of food is the Locker Plant.

A modern locker plant may offer many services in addition to the primary service of freezing and storing frozen foods. Often there are butcher-shop facilities for slaughter, hanging, cutting and boning, sausage making, lard rendering, meat smoking and curing. Frozen foods may be retailed. Sometimes kitchen facilities are provided for processing fruits and vegetables.

Locker plants in Ontario operate under licence from the Provincial Government and conditions in the plant pertaining to public health and food quality must meet requirements before a licence can be obtained. The owner of the locker plant has a large investment in the plant and he has a large running expense.

Many locker plant operators have found it necessary to keep records on all materials going in or out of lockers and, in any case, the operator is responsible for inspection of food going into the locker.

All of the above operations and services cannot be done for nothing. It is usual therefore to charge a yearly rental for a locker, which the customer may fill and empty as often as he pleases, and to place a charge per pound (or other unit) of food for specific services performed for the customer.

THE HOME FREEZER

Another facility available for the freezing preservation of food is the home freezer. It may be a walk-in room or a box. They are available in almost any size. The principle of operation is similar to an ordinary kitchen refrigerator but the home freezer maintains approximately 0° F. instead of the 40° to 50° F. in the food compartment of a kitchen refrigerator. Combinations of freezer and cool spaces are available, and the ice-cube compartment of a kitchen refrigerator can be used for short holds of frozen foods.

The home freezer is built to freeze a certain poundage of food in a certain time. The manufacturers' directions should be followed closely as to amounts of food which may be frozen at one time.

RETAILED FROZEN FOODS

Most frozen foods are available at retail. The question is asked commonly as to how long frozen foods may be held safely in the home without danger. It isn't possible to answer the question with a fixed period of time since the numbers and kinds of bacteria vary with each lot of food. In general, frozen flesh is much like fresh flesh when the former is defrosted. The fact that it usually "sweats" while defrosting provides good opportunity for the development of bacteria and molds. Fruit loses quality rather quickly after defrosting. Later molds may develop or yeast fermentation may take place. Loss of eating quality alone makes necessary the immediate use of fruits when they are defrosted. Vegetables lose quality and they may become unfit for food within a few hours after defrosting.

Frozen foods may be held frozen for a few days in the ice-making compartment of a kitchen refrigerator. Several layers of paper or towelling will retard the defrosting over a period of hours even at kitchen temperature.

QUALITY IN FROZEN FOODS

Some advertising and popular writings about frozen foods have led to the impression that one can freeze any kind and quality of food and get an excellent product. Actually, many foods deteriorate seriously when frozen. High raw quality is essential to a good frozen product. Freezing is not a cheap method of preservation and its chief claim to utility is the eating quality that can be preserved when the freezing method is used properly on foods which submit themselves to the freezing method. Old cow meat is still old cow meat after freezing. Tainted fish retains its taint after freezing. Overripe peas are most unattractive eating after freezing. Some of us believe that anything less than good quality is not worth freezing.

SECTION II

FROZEN FRUITS AND VEGETABLES

By J. H. L. TRUSCOTT

Fruits and vegetables when harvested are living tissues which may undergo rapid deteriorative changes. It is important that such tissues be handled quickly and be kept as cool as possible until they are processed and frozen.

Some kinds of fruits and vegetables are not suitable for freezing. For instance, it isn't possible to retain raw apple flavour and texture in whole apples though sliced apples are frozen for pies. Similarly vegetables which are ordinarily eaten raw and which must be crisp to be attractive will not retain the crisp character after freezing. Examples are celery, lettuce, radish and cucumbers.

VARIETIES

The most common cause of disappointment in the eating quality of frozen fruits and vegetables is the use of varieties which do not freeze with retention of good quality. Excellent table quality when fresh is not a guarantee of excellent frozen quality. The only known method of determining whether a variety will retain quality after freezing is to examine it after it has been frozen. Many institutions, including this one, have spent years testing the freezability of thousands of fruit and vegetable varieties. As an example, we have tested approximately 100 varieties of peas and we have found only 5 or 6 varieties which combine good freezing quality with acceptable yields in our soils and climate. We are constantly testing new varieties of fruits and vegetables as they are made by plant breeders. In some instances, strawberry for example, we do not have a variety which freezes with better than fairly good quality and at the same time provides good yields in the field. Some varieties of fruits and vegetables have good frozen quality some seasons and very ordinary quality in others.

MATURITY

An otherwise good variety of fruit or vegetable may be ruined as a frozen product by being harvested undermature or by allowing it to become overmature by delay before processing. Vegetables usually lose desirable flavour, colour, and become tough with overmaturity. Fruits may become too soft to make a good-looking product and off-flavours may develop if they are seriously over-ripe.

Undermaturity in vegetables usually results in a frozen product which is too soft and which lacks flavour. Undermature fruits are too hard, tasteless and often have poor colour.

Generally the best maturity for freezing is that which gives best table quality when the fruit or vegetable is eaten immediately after harvest. Individual preferences for such as "chewiness" in peas or corn-on-the-cob can be satisfied by harvesting at the desired maturity.

On the whole it is easier to get good quality in frozen vegetables than in frozen fruit because vegetables are ordinarily eaten after cooking and the texture is expected to be soft. Fruits are ordinarily eaten as uncooked desserts and undue softening, due to freezing, is not desirable.

Fruits may be partially cooked before freezing but they acquire a cooked flavour, and it has not been a popular method. All fruits benefit from the preservative effects of sugar, either when applied as a cold syrup (sugar plus water) or when sugar is mixed with crushed or sliced fruit and allowed to form a syrup with the fruit juice before freezing.

All vegetables must be partially cooked before freezing for long storage. Otherwise they gradually lose colour and acquire a flavour usually described as "grass like" or like heated hay.

Obviously all fruits and vegetables must be thoroughly washed, graded, and trimmed before freezing.

FRUITS

Some fruits may be frozen without a covering liquid but all fruits are improved by the protection afforded by a syrup. The liquid covering is a necessity in those fruits which darken readily when in contact with air.

Syrups

The strength of syrup used depends partially on the user's preference. The weakest syrup which affords the necessary protection to the fruit contains approximately 25% to 30% sugar, or that known as a "light" syrup in home canning procedures. Medium syrups may be used, if preferred, and they sometimes provide better protection of flavour and texture than a light syrup. We find that the excessive sweetness of heavy syrups masks the flavour of the fruit.

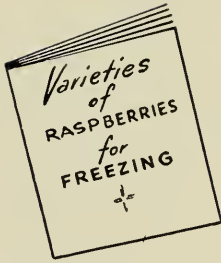
We make the syrup by adding sugar to cold water and dissolve it by stirring. We find no advantage in boiling the mixture. The syrup should be as cold as possible when added to the fruit.

A 25% syrup consists of 25 ounces of sugar to 75 ounces of water. The proportion is 1 of sugar plus 3 of water by weight. Sugar and water weigh approximately alike so that 1 cup of sugar added to 3 cups of water will provide an approximate 25% syrup.

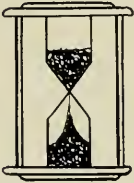
Vitamin C (ascorbic acid) is useful in the partial prevention of the development of brown colour in frozen peaches and other fruits. Only a small amount of ascorbic acid is necessary. From 150 to 250 milligrams of ascorbic acid has been recommended for each pound of fruit-syrup mixture. If the acid is bought in bulk the proportion for use is about $\frac{1}{4}$ teaspoon of ascorbic acid to 1 quart of syrup. This mixture will cover about 4 quarts of packaged fruit. Ascorbic acid is bought as a white powder resembling fine sugar. Its cost makes advisable the use of no more than is required. However, if an error is made the material is not poisonous. It is found naturally in most fruits and vegetables.

Many fruits taste better if they are sliced or crushed and mixed with dry sugar before freezing. A proportion of 1 of sugar to 5 or 6 of fruit by weight contains enough sugar to protect the fruit flavour. More sugar may be used if desired. The sugar dissolves in the sliced or crushed fruit juice as the mixture is stirred gently. It is difficult to give volume measurements for the different fruits but if a scale is not available the following example will give some idea of volumes of fruit and sugar for an approximate 1 to 5 mixture. One, eleven-quart basket of peaches will provide about $10\frac{1}{2}$ pounds of sliced fruit. Add 4 cups (2 lb.) of sugar. The yield is about 5 American quarts of mixture.

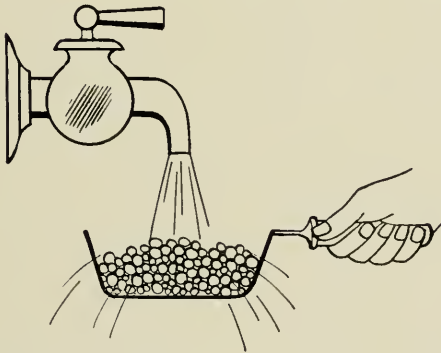
TO FREEZE FRUITS



1. Use suitable varieties.

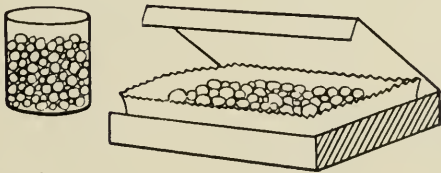
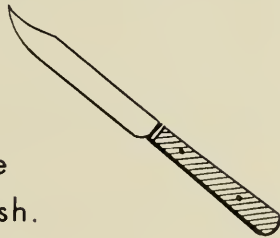


2. Pick it at the right maturity.



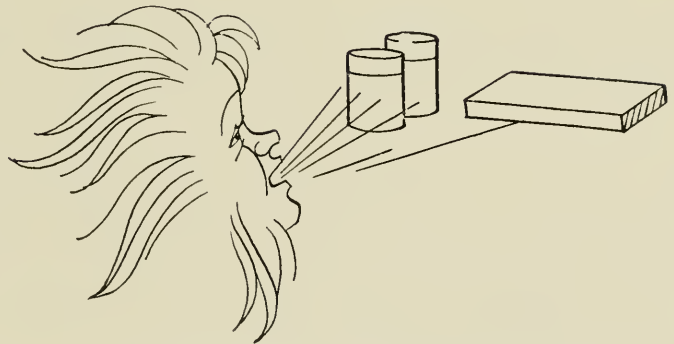
3. Wash it clean.

4. Peel,
Pit,
Trim, Grade
Slice or Crush.

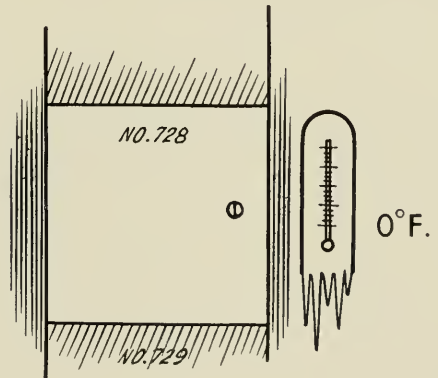


5. Pack.

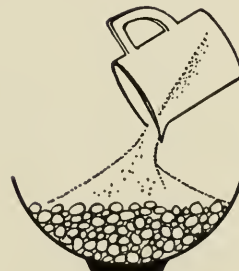
6. Add syrup



8. Freeze it as soon and as fast as possible.



9. Store at 0°F. or lower.



OR add sugar.



Dissolve the sugar
and then pack.



7. Wrap the package and seal it.

When ascorbic acid is used with the sugar-fruit mixture it is convenient to first shake the sugar and ascorbic acid in a large jar to mix it. Use about $\frac{1}{4}$ teaspoon of ascorbic acid to 2 lb. (4 cups) of sugar. This mixture is added to 10 to 12 pounds of sliced or crushed fruit.

Finely crushed fruits or mixtures of fruits, with sugar, have several uses. Recipes for proven mixtures may be obtained by writing to the Dominion Department of Agriculture, Ottawa, Ontario.

A weighing scale is almost a necessity for both canning and freezing. The spring type which weighs to about 20 pounds is accurate enough for home processing and it is relatively inexpensive. Don't forget that the scale that weighs the baby has other uses.

(The sugar-fruit mixture described above is worth trying when canning sliced peaches and pears.)

Each kind of fruit will be discussed separately and the varieties recommended will be listed in a separate section.

Apple

Apples are frozen in the sliced form for subsequent use in pies. Apple sauce may also be frozen. Sliced apples will become brown in colour and lose flavour unless treated before freezing. Various treatments are used in commercial production of sliced frozen apples, but the method suggested for home use is to slice the apples into a weak brine (about 1 teaspoon of salt to 1 quart of water) so that discolouration is largely prevented during the slicing operation. Then cook for a short time in boiling water. The time will vary depending on the variety of apple and its maturity. Overcooking will result in the slices becoming too soft. Undercooking will allow deterioration of the frozen product. About two minutes in boiling water is sufficient for the average lot of sliced apples. Pack in containers large enough for fruit for one or two pies. Freeze. Part or all of the sugar necessary for the pie may be added before freezing.

Apricot

Relatively few apricots are grown in Ontario. Halve the fruit and remove the pits. Cover with syrup. Freeze.

Blackberry

Pack as whole fruits in syrup or lightly crushed in sugar. This berry must be full ripe before freezing otherwise the frozen berries become red in colour and are very sour. Suitable varieties have excellent frozen quality.

Black Raspberry (Black Caps)

Most varieties are best when lightly crushed with sugar. Some are good in syrup. If the available variety is unknown or if the berry is frozen for the first time it is suggested that most of the pack be the crushed fruit-sugar mix.

Cantaloupe

The claim is made occasionally that halves or even whole cantaloupe have been frozen successfully. Our experience is that much better results are obtained by cutting the edible portion into one-half to three-quarter

inch cubes, or into rounded balls, before freezing. The pieces of fruit may be packed without sugar or syrup but we prefer a covering of light syrup. It is important that the fruits be eating-ripe before freezing.

Cherry, Sour

Sour cherries freeze with excellent quality for pies. Pit them and add sugar. Allow most or all of the sugar to dissolve before packing. Use the amount of sugar preferred in pies. A syrup pack is good but there is more liquid than can be used in the pie.

Cherry, Sweet

Light coloured sweet cherries freeze with only fair quality. The flavour is too mild and they tend to discolour. Several common varieties of black sweet cherries freeze with from fairly good to excellent quality when pitted and covered with syrup, or when sugar is dissolved in the pitted fruit. We prefer the sugar-fruit mixture. One variety "Velvet" freezes with quite good quality without pitting or stemming and without sugar or syrup. When frozen "as is" this cherry should be eaten immediately after thawing in cold water. It is excellent when pitted and mixed with sugar.

Blueberry

This fruit grows only in areas having suitable soils. It is often frozen "as is" but its quality is improved when the berries are covered with syrup.

Currant, White, Red and Black

Currants are usually frozen for use in pies or tarts. Black or red varieties are usually preferred. We prefer to add enough sugar for use in pies or tarts and to lightly crush the fruit so that most of the sugar is dissolved before freezing. Frozen black currants are a good source of vitamin C and most varieties, when ripe, freeze with excellent quality. Black currant addicts may like the uncooked fruit-sugar mix on toast or as a relish.

Cranberry

This fruit grows only in areas with special soils. It is ordinarily frozen "as is".

Gooseberry

Most gooseberries are marketed immature and green in colour. We prefer to cut the berries in half and add the amount of sugar necessary for pies or tarts. Allow the sugar to dissolve before freezing. Ripe gooseberries are relished by many persons. They may be frozen "as is" or with a covering of syrup.

Grape

Grapes need special care in washing to remove undesirable spray deposits and other foreign materials. They may be frozen as small bunches or as detached berries. It is important that they be ripe. The characteristic flavour of each variety is preserved rather well by freezing. The berries of some varieties split when they are frozen. We prefer a covering of light syrup. The recommended varieties should provide a satisfactory product if those varieties are relished in the fresh condition.

Peach

The eating quality of frozen peaches can be very good and it can be extremely disappointing. A variety of peach may provide a good frozen

product one season and an inferior one the next. It is difficult to maintain suitable texture in the soft flesh of a ripe peach and most of the commoner varieties tend to discolour readily.

The most reliable method of preparation is to peel and pit the firm-ripe fruit, slice it into eighths or twelfths, add sugar (about 1 pound of sugar to 6 pounds of sliced fruit), turn the mixture with a spoon a few times, carefully, until the sugar is dissolved and freeze the mixture. Vitamin C (ascorbic acid) may be added as suggested under the heading "syrops", as an aid in reducing discolouration.

The varieties recommended usually provide satisfactory packs. It is advisable not to freeze late varieties such as Elberta when autumn conditions are such that the fruit has been subjected to lengthy periods of cold temperatures before harvest.

Pineapple

This imported fruit is often frozen and the quality is good if the fruit is ripe. Dice the edible portions into half-inch cubes. It may be packed "as is", with sugar or with syrup.

Plum

Plums must be ripe before freezing. Cut the fruit in half and remove the pit. Many varieties freeze with only poor to fair quality, and only small, trial packs are recommended for those freezing plums for the first time. Prunes and Damsons are preferred to other types generally, and we prefer to cover the fruit with a light syrup.

Raspberry

Most readily available varieties of raspberry provide a satisfactory pack when lightly crushed and mixed with sugar. The Cuthbert variety may be relied upon to have good quality when frozen as a whole berry with or without sugar or syrup, but it is becoming increasingly scarce. Most varieties maintain their appearance and texture when frozen whole but the flavour of most of them is disappointing. The frozen quality of a variety of raspberry may vary considerably from season to season. Despite the above opinion of the frozen quality of whole raspberries, it is a popular frozen fruit.

Rhubarb

The red varieties of rhubarb are generally preferred for freezing. Harvest the tender early growths for best quality. The stalks are generally cut into inch lengths and frozen "as is". Or it may be partially or fully cooked before freezing. Frozen rhubarb of good quality is popular.

Strawberry

Most readily available varieties of strawberries when frozen whole retain only fair quality. They are soft in texture and the flavour may be altered rather seriously. The recommended pack for common varieties of strawberry is to slice each berry into 2 or 3 pieces, add sugar at the rate of about 1 pound of sugar to 5 pounds of berries, allow the sugar to dissolve with a minimum of stirring, pack and freeze.

The water used to wash the berries should be as cold as possible and used as briefly as possible. Otherwise the berries lose appearance quickly by becoming water-logged.

VEGETABLES

Vegetables should be harvested for freezing when they are in the condition best suited for immediate use. They are cleaned and, if necessary, cut into serving pieces. They should be carefully graded so that only the best material goes into the freezer. A few over-mature peas mixed with an otherwise suitable lot can spoil the appearance and eating quality of the lot, and bitter, tough, butts of asparagus ruin the eating pleasure of the tender portions.

Partial Cooking, Blanching or Scalding are terms used to describe the heating of vegetables before freezing. This part of the processing of vegetables is often not understood and some argue that heating isn't necessary. However, unless vegetables are used soon after freezing, they will lose colour and develop peculiar, offensive flavours if they are frozen "as is". A few vegetables are fully cooked before freezing. The remainder of them require partial cooking. The necessary amount of cooking depends on the size of the serving pieces, and varies from 2 minutes for green peas to 8 minutes for medium-size cobs of corn. The vegetable must be heated sufficiently that the centre of each piece reaches the temperature of boiling water. Sufficient heating destroys chemical enzymes which cause deterioration of frozen vegetables during storage.

The most reliable home method of cooking is in boiling water and the cooking is timed in *actually boiling* (bubbling) water. Vegetables deteriorate if they soak too long in merely hot water. We advise using two (or more) pots of water with the highest available heat under each.

Place about 1 pound of vegetable in the centre of a square of cheese cloth (or any clean, dye-free, open mesh cloth). A convenient size is about 24 inches square. Gather the 4 corners into the hand and dip the vegetable up and down in the first kettle while counting slowly to 20 or 30 (20 seconds approximately). Lift it out and drop it into the second kettle of boiling water. Move the bag a few times to allow the water to sluice through the mass of vegetable pieces. The second kettle should return to the boil quickly since the vegetable was pre-heated in the first kettle. Begin timing when the second kettle begins to boil. Most alarm clocks can be set as a reminder.

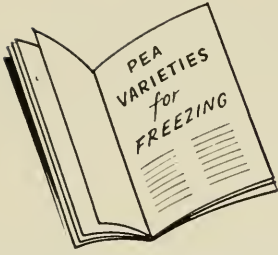
The ends of the bag can be draped over the top of the kettle, or its handle, for convenient lifting when the batch is cooked sufficiently. *Then remove the bag to a kettle or sink of cold water*—preferably running water. Leave until the water draining out of the bottom of the lifted bag feels cold to the hand. Drain briefly and pack in a suitable container. Directions for heating times will be given later for each vegetable.

Overcooking will result in loss of flavour. Undercooking will result in loss of colour and change of flavour during storage in the freezer. It is better to err on the side of overcooking if errors are anticipated.

Prompt and complete cooling is nearly as important as the cooking if top quality is expected.

Packing is done in two ways and both have advantages. A weak brine, added cold, may be used as a covering liquid in the packages of blanched, cooled and drained vegetables. The brine is made by adding 1 teaspoon of salt to 1 quart of cold water. The brine pack improves the

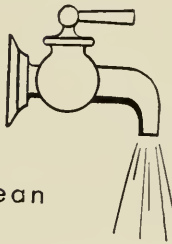
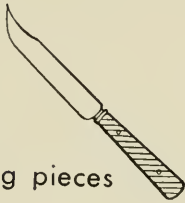
TO FREEZE VEGETABLES



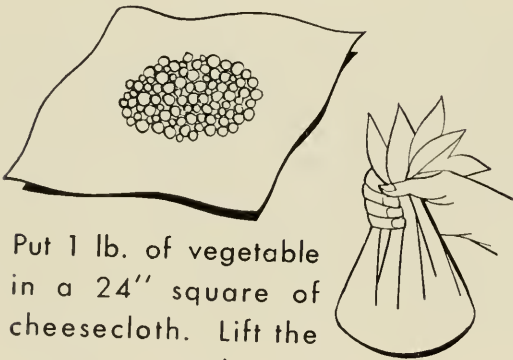
1. Use recommended varieties

2. Trim
Peel
Grade

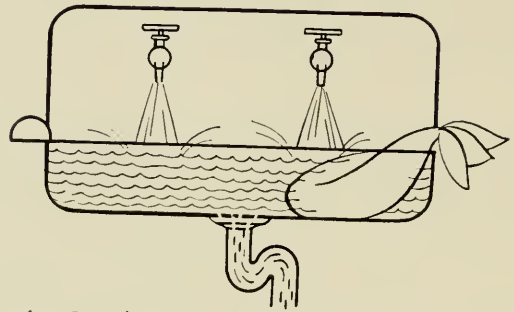
Cut to serving pieces



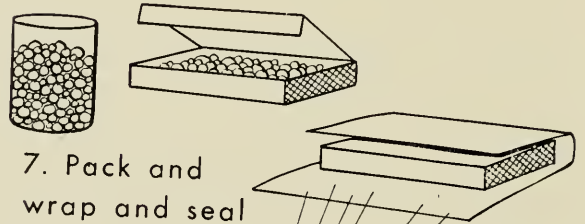
3. Wash clean



4. Put 1 lb. of vegetable
in a 24" square of
cheesecloth. Lift the
corners to make a bag.



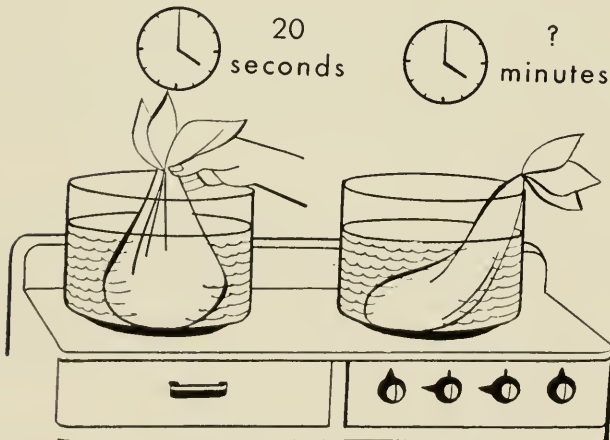
6. Cool the vegetable in cold water



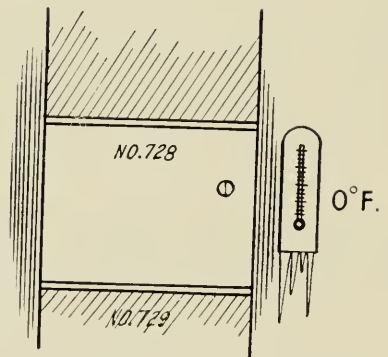
7. Pack and
wrap and seal



8. Freeze quickly



5. Dip the vegetable in kettle #1 for about
20 seconds — then leave in kettle #2 for
the recommended time for each vegetable.



9. Store at 0°F. or lower

flavour of some vegetables, helps to control freezer-burn (drying out) and provides a reserve of refrigeration when the package is removed from the freezer room.

On the other hand vegetables packed without the liquid covering are more quickly ready for use after removal from the freezer, the packages do not leak before freezing, and in some instances the vegetable may have better flavour.

When *brine pack* is recommended it refers to covering the vegetables with a brine (1 teaspoon salt to 1 quart of water). When *dry pack* is recommended it refers to packaging the briefly drained vegetable without a covering liquid.

Practically all commercially prepared frozen vegetables are *dry pack*. The housewife may use either method with success.

Cooking Frozen Vegetables.

Freshly thawed vegetables such as peas, carrots, asparagus, snap beans, and cut corn may be used without further cooking as salad ingredients.

If the vegetable is served hot it should be placed while still frozen, into the least amount of boiling water that will cover it. Add salt as in cooking fresh vegetables. If the vegetable was frozen in brine use the brine as part of the cooking liquid.

Don't over-cook.

The vegetable was partially cooked before freezing and freezing softened it further. Excellent frozen vegetables can be ruined by over-cooking or by "keeping them hot" for undue lengths of time after they are cooked.

Asparagus

There is only one commonly grown variety and it freezes with excellent quality. This vegetable loses its quality quickly after harvest unless it is chilled. Wash carefully in plenty of cold water. If it has been harvested after a driving rain it may be necessary to wash it in warm water to eliminate sand from the leaflets on the stem, or the leaflets may have to be removed. Chew some pieces from time to time to be sure the sand is gone. Freeze only the tender tips and trim them to fit the package used. Green butts may be packed separately for a soup ingredient. Grade the stalks into sizes, blanch $\frac{1}{2}$ " or smaller, 3 minutes; larger sizes, 4 minutes. Cool. Pack either dry or preferably in brine. It is one of the excellent frozen vegetables, and it can be served in salad or after boiling for 3 to 5 minutes.

Beet

Young beet root and beet tops make good frozen products. We prefer to fully cook the beet roots, cool, remove the skin, pack dry. If heated in a minimum of water for serving hot there is little loss of colour. Thoroughly wash the beet tops, blanch 4 minutes (see Spinach), cook, drain, pack dry. Young beet tops often have red veins and stems and make a colourful "spinach".

Broccoli

Broccoli needs thorough washing since it is often infested with plant lice or green worms. Harvest before any colour shows in the heads

and retain only tender parts of the stem. Blanch 4 to 5 minutes depending on the size of the heads. Cool. We prefer a brine pack. Cook about 5 minutes. It may be used as a salad ingredient without cooking. An excellent frozen product.

Brussels sprouts

Wash, trim and inspect for green worms. Blanch average size heads 5 minutes. Insufficient blanching results in the development of very obnoxious flavour during storage. Cool, we prefer a brine pack. Cook about 6 minutes. A good product.

Carrot

Young carrots freeze with from fair to good quality. Blanch 3 minutes or fully cook roots of from $\frac{3}{4}$ to 1 inch thickness. Cool. We prefer a brine pack.

Cauliflower

Wash carefully and inspect for worms. Cut into serving pieces. Blanch 4 minutes. Cool. Preferably packed in brine. Purple varieties lose the purple colour during processing and become light green. Both white and purple types freeze with good quality.

Corn—cut

Sometimes cut corn is good, sometimes not very attractive. Very special attention must be given to maturity and variety. Blanch 4 minutes on the cob, cool, cut the grain off, pack and freeze. Dry pack preferred.

Corn-on-the-cob

Sometimes good, sometimes not attractive. It is wasteful of space in the freezer. But a good variety, picked right is worth freezing for special occasions. Blanch, after removing silks and husks, 5 to 6 minutes for medium sized ears and 7 to 8 minutes for larger varieties. Cool thoroughly in water. Pack. Brine pack often holds quality longer than dry pack. Dry pack is preferred for holds of 6 to 8 months.

Egg Plant

Freezing is probably the only suitable method for long-term preservation of egg plant. The frozen product can be good. It is important that the seeds of the fruits are soft. Best results have been obtained by slicing the fruit into $\frac{1}{2}$ -inch slices after peeling. Blanch two minutes, cool and pack. The slices darken during the blanching. The slices may be pan-fried or dipped in batter for frying after partial defrosting.

Kale

Tender leaves of kale were blanched 4 minutes before freezing. The product had fair quality but it required long cooking and tended to be coarse in texture.

Kohlrabi

Tender heads were peeled, diced into $\frac{1}{2}$ -inch cubes, blanched 4 minutes, cooled and packed. The product had excellent cooked quality.

Lima and Horticultural Beans

Several varieties of lima beans will grow reasonably well in those parts of the province with reasonably long frost-free season. They should be harvested when the seeds are green. Wash the pods clean and remove the seeds. The pods may open more readily if they are blanched and cooled.

Blanch the pods 4 minutes, or if the seeds are free of the pods, blanch 3 minutes. Cool and pack. The amount of cooking required will vary with the maturity of the seed when frozen. Treat Horticultural beans as limas.

Okra (Gumbo)

The seed pods should be harvested when tender. Wash thoroughly, blanch two minutes, cool, pack either whole or sliced. The vegetable is used in soups and stews and it helps to thicken the mixtures as well as flavour them. Its frozen quality is good.

Parsley

The frozen quality of parsley was poor to fair after freezing. It was flabby and water-soaked but its flavour was normal. Frozen parsley can be used as flavouring in soups and stews. It may be blanched two minutes before freezing or frozen "as is" after suitable packaging.

Pea

Frozen peas are a popular food. Wash the pods thoroughly before removing the seeds. Blanch the seeds 2 minutes, cool, pack. It is highly important to harvest peas at proper maturity. Overmaturity results in poor flavour, undermaturity usually results in the skins breaking or wrinkling. Only a few varieties will freeze with excellent quality. Peas change rapidly after harvest and must be kept cool and processed as quickly as possible.

Pepper

Either green or ripe sweet peppers make a successful frozen product. Good results have been obtained by slicing the fruits, removing the seeds, pulp and stem, and by blanching for 2 minutes. The slices freeze well without blanching but they are difficult to pack unless softened by blanching. Frozen peppers may be used in the same manner as fresh peppers.

Pumpkin and Squash

Most of the commoner varieties of squash and pumpkin have been frozen. One method is to dice the edible portions into one-half to one-inch cubes, blanch 4 minutes, cool and pack. The resulting products are usually quite edible but the flavour may be changed somewhat. We prefer to fully cook and mash both pumpkin and squash as for immediate use. Then cool and pack. The characteristic flavour and colour of each variety has been preserved well when they were frozen after being fully cooked.

Snap Bean (String Bean)

The flavour of both green and yellow snap beans tends to be weak after freezing. The pods should be harvested when the seeds are very small and the pod tender. The pods need thorough washing. Trim the ends of the pods. Blanch the pods 4 minutes and cool them. The blanched, cooled pods may be packed whole, or they may be cut crosswise or cut lengthwise before packing.

Soy Bean

Edible varieties of soy beans, harvested when the seeds were soft were frozen with retention of good quality. The seeds may be removed from the pods more readily if blanching is done in the pod. Blanch the pods 4 minutes, cool, extract the seed and pack.

Spinach

Spinach should be harvested before the blossom begins to form. Washing the leaves free from sand is always a problem. We find that kneading about one pound of leaves in a large pan, or sink, full of cold water is effective. The leaves become turgid and bulky. The scalding bag must be pushed into the hot water with a spoon until the leaves collapse. The sodden green mass needs to be moved frequently during a blanch of 4 minutes. Cool and twist the neck of the bag to remove most of the water. Pack. Frozen spinach is a good product.

Squash (see Pumpkin)

Swiss Chard

Remove the thick ribs in the leaves and either discard them or process them separately. Blanch the leaves 4 minutes as for spinach.

Tomato

Pulp or juice of tomato may be frozen "as is" but we prefer the flavour if it is brought to the boil and cooled before freezing. No variety so far tested will retain its texture after freezing as slices, or as whole tomatoes for slicing.

Watermelon

Diced flesh of some of the watermelons grown in Ontario has retained fairly good quality when frozen "as is". Only small, trial packs are recommended.

RECOMMENDED VARIETIES OF FRUITS AND VEGETABLES

A rating of XX beside the variety name means that it generally freezes with retention of fair to fairly good quality. A variety rated XXX generally freezes with good quality.

An (0) beside the name indicates a variety which may have to be ordered by a retail seedsman. The other varieties listed are generally readily available. Many other varieties have been tested and found suitable for freezing but the seed is not yet available, or, if a fruit, it is not grown commonly.

This section will be revised from time to time as more information is available or seed stocks become obtainable.

The kinds and varieties of fruits and vegetables are in alphabetical order.

ASPARAGUS

Mary Washington
(xxx)

BEET

Crosby Egyptian (xxx)
Detroit Dark Red (xxx)
Early Wonder (xxx)

BLACKBERRY

Lowden (xxx)

BROCCOLI

Green Sprouting (xxx)

BRUSSELS SPROUTS

Long Island Improved
(xx)

CANTALOUPE

(0) Bloomsdale Sugar
Cup (xxx)
Hearts of Gold
(xxx)
(0) Sugar Salmon
(xxx)

CARROT

Early Chantenay (xx)

CAULIFLOWER

Danish Giant (xxx)
Early Dwarf Erfurt
(xxx)
Snowball (xxx)

CHERRY

Black Tartarian (xx)
Early Richmond (xxx)
Hedelfingen (xx)
Montmorency (xxx)
Schmidt (xx)
Velvet (xxx)
Vernon (xx)

CORN

Cream O'Gold (xx+)
 Early Pearl (xx+)
 Erie (xx)
 Goldban (xxx)
 Golden Bantam (xx)
 Golden Bantam
 (Gunson) (xxx)
 Golden Early Market
 (xx+)
 Golden Gem (xx+)
 (0) Harris Extra Early
 Bantam (xxx)
 Harris Golden Bantam
 (xx+)
 M-13 (xx+)
 Seneca Chief (xx+)
 Seneca Hybrid (xx+)
 7/8 Midget (xx+)
 Spancross (xx)
 Tendergold (Assoc.)
 (xx+)
 (0) Vinecross B5
 (xxx)

CURRENT (BLACK)

Baldwin (xxx)
 Kerry (xxx)
 Magnus (xx)
 Naples (xx)
 Saunders (xxx)

EGGPLANT

Black Beauty (xx)
 New York Purple (xxx)

GOOSEBERRY

Clarke (xxx)

GRAPE

Agawam (xx)
 Cayuga (xx)
 Concord (xxx)
 Red Rogers (xx)
 Seneca (xx)

HORTICULTURAL BEAN

Brilliant Hort. (xx+)
 Dwarf or Cranberry
 (xx+)
 Dwarf Horticultural
 (xx+)
 French Horticultural
 (xxx)
 Italian Horticultural
 (xx+)
 Jackson Wonder Bush
 (xxx)
 London Horticultural
 (xxx)
 Lowe's Champion
 (xx+)
 Seneca Horticultural
 (xx)

KOHL RABI

Purple Vienna (xxx)
 White Vienna (xxx)

LIMA BEAN

Clark's Bush (xx+)
 Concentrated Fordhook
 (xx)
 Dixie Butterpea
 (xxx)
 Florida Butter Special
 (xx+)
 Henderson's Bush Lima
 (xxx)

OKRA

Early Dwarf (xxx)

PEA

Acquisition (xx+)
 Alderman (xx+)
 American Wonder
 (xx+)
 Early Bird (xx+)
 Fenland Wonder
 (xx+)
 Gradus Improved
 (xx+)
 Laxtonian (xx)
 Laxton's Progress
 (xx)
 Meteor (xx+)
 Miracle (Ferry)
 (xx+)
 Morse's Progress # 9
 (xxx)
 Prizewinner (xx+)
 Sharpe's Unique
 (xx+)
 Sutton's Excelsior
 (xx+)
 Tall Telephone (xxx)
 Thomas Laxton (xxx)
 Thomas Laxton
 Improved (xx+)
 Witham Wonder
 (xxx)

PEACH

Elberta (xx)
 Jerseyland (xx+)
 Redhaven (xx)
 Sunbeam (xx)
 Valiant (xx)
 Vedette (xx)

PEPPER

Early Pimento (xxx)
 Early Wonder (xxx)
 Harris Earliest (xxx)
 Hungarian Yellow
 (xxx)
 Oakview Wonder (xx)

PLUM

Damson (xx)
 Italian Prune (Fallen-
 burg) (xxx)
 Pacific Prune (xxx)

Stanley (xx)
 Washington (xx)

RASPBERRY

Cuthbert (xxx)
 Latham (xx)
 Viking (xx)

SALSIFY

Sandwich Island
 (xxx)

SNAP BEAN

Black Valentine (xxx)
 Blue Lake Stringless
 (xxx)
 Burpee's Brittle Wax
 (xxx)
 Burpee's Stringless
 Green Pod (xxx)
 Cangreen (xxx)
 Cornfield White (xx+)
 Early Stringless Wax
 (xxx)
 Early Thorogreen
 (xx+)
 Extra Early Wax
 (xxx)
 Long Tendergreen
 (xx+)
 Potomac (xx+)
 Rival (xx+)
 Stringless Black
 Valentine (xxx)
 Tendergreen (xxx)
 Unrivalled Wax (xx)
 Webber Wax (xx)

SOY BEAN

Funk Delicious (xxx)
 Keith's Soy (xxx)
 Mendata (xxx)

SPINACH

Giant Nobel (xxx)
 New Zealand Spinach
 (xxx)
 Princess Juliana (xx)
 Virginia Savoy (xx)

SQUASH

Buttercup (xxx)
 Butternut (xxx)
 (0) Golden Delicious
 (xxx)
 Golden Hubbard
 (xx+)

STRAWBERRY

Premier (x)
 Sparkle (xx)
 Valentine (xx)

WATERMELON

Honey Cream (xx)

SECTION III

FROZEN POULTRY

By E. S. SNYDER

Freezing has long been used to preserve poultry, but the introduction of modern freezing methods and greater interest in the quality of the frozen product has stimulated considerable experimentation with frozen poultry and poultry products. Much of the work of the past few years has been on chicken and turkey. There is still relatively little printed information on goose and duck.

If recommended methods are followed in the selection for quality, preparation, cooling, freezing, packaging and storage, frozen poultry is one of the most successful frozen foods.

SELECTION OF POULTRY FOR FREEZING

Eating quality in frozen poultry depends on the quality of the bird when slaughtered; also on immediate and rapid cooling following slaughter. Drawing and any further processing is most easily done after cooling though the practice of hot drawing, then chilling, is on the increase commercially.

In selecting poultry of any kind for freezing, preference should be given to grade Special, grade A and the better grade B birds graded according to Canadian Dressed Poultry Standards. (While freezing may have a slight tenderizing effect on the flesh, the effect is not so great as to change boiling fowl, stags and old turkeys, geese or ducks to the tenderness of young birds.)



Fig. 1. From right to left, typical A, B and C grade fowls, illustrating the desirable type, fleshing and finish of Grade A as compared with the less desirable Grades B and C.

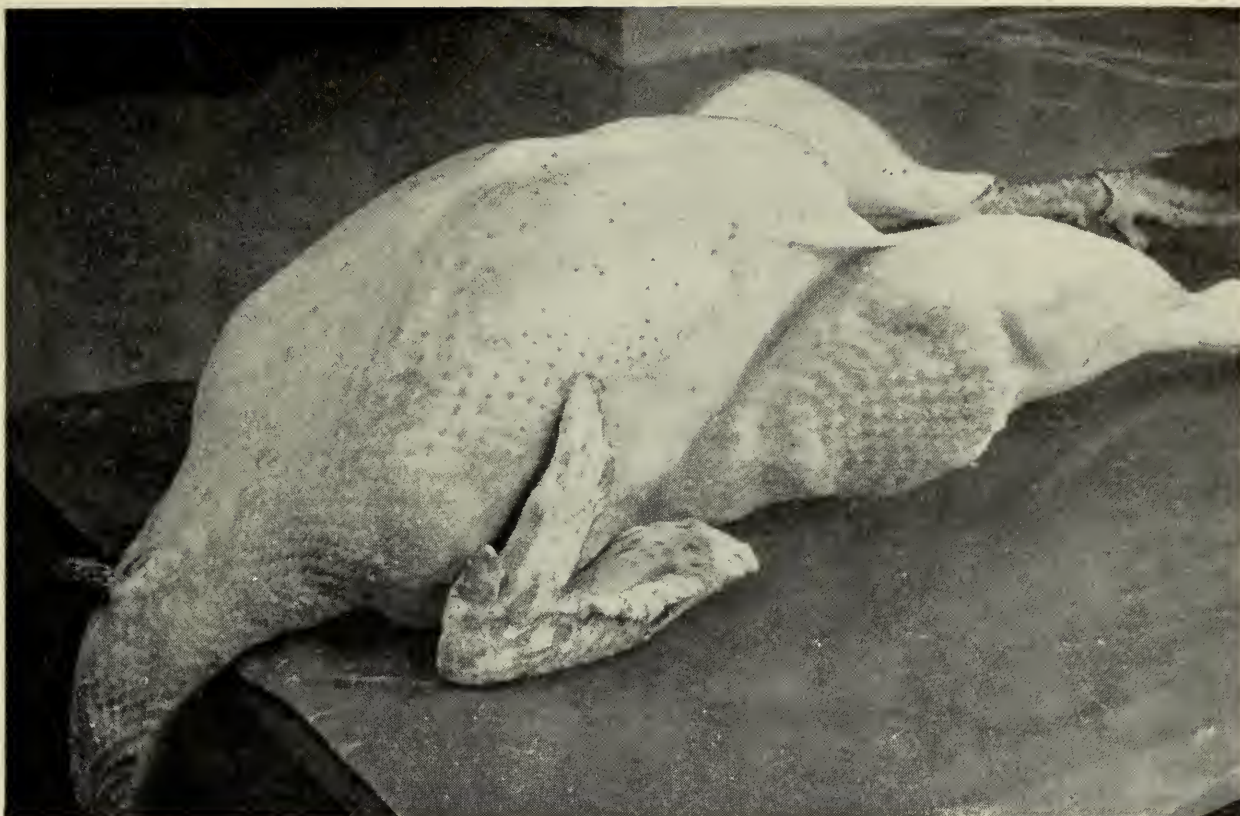


Fig. 2. A grade Special turkey carcass, showing the wealth of fleshing, fine finish, and attractive appearance common to top grade birds.

1. **Chicken**—Birds of the above quality will be compact in body, well-fleshed in breast, thighs, drumsticks and back. They will carry at least a moderate amount of skin and internal fat and will be straight-breasted and free from tears, blemishes, abrasions and discolourations.

2. **Turkey**—Birds of the broad-breasted type carrying a moderate amount of fat are most satisfactory. They, like chickens, should be well



Fig. 3. A half turkey. An excellent way of preparing a large turkey for freezing; or the bird may be drawn and frozen,—then sawn into halves or quarters as desired.

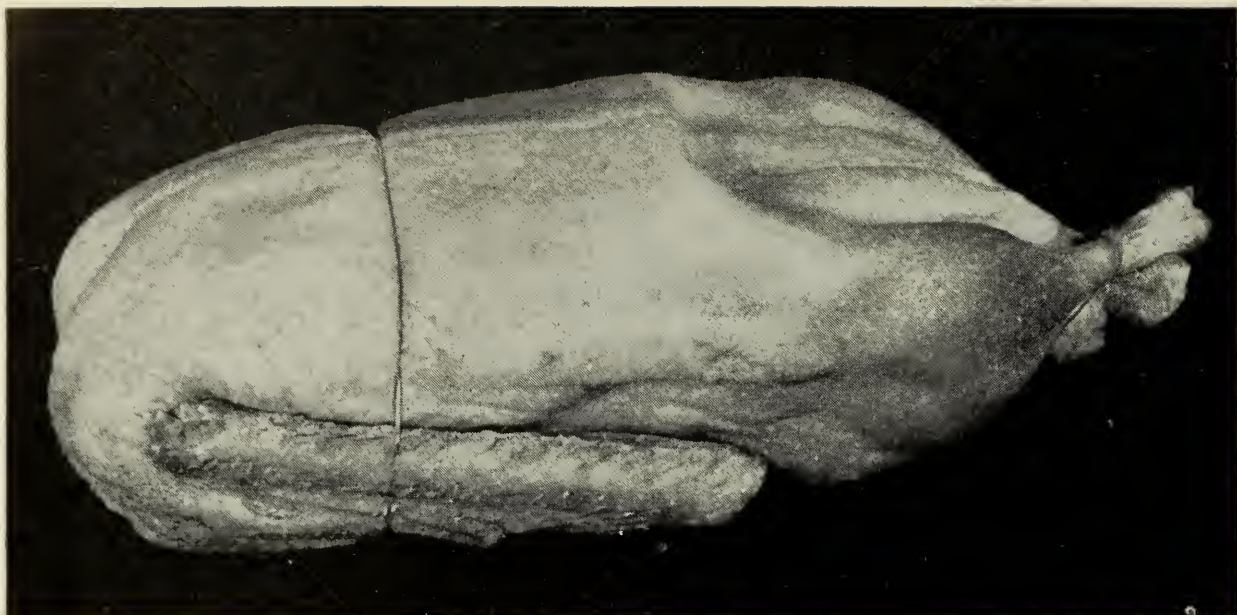


Fig. 4. A well-dressed Grade A goose carcass, drawn and ready for wrapping in preparation for freezing.

dressed, free from discolouration and show plenty of bloom. Small to medium sized turkeys are frozen whole.

Large turkeys may also be frozen whole or they may be drawn, then cut in half or quartered for use according to the size of the family or number of persons to be served at one time. In this way large turkeys, because of their lower price per pound, are economical as compared with the higher priced but more popular smaller birds.

3. **Duck**—Preference is given to broad-breasted, deep-fleshed birds, moderately fat but not excessively so.

4. **Goose**—The above is also true of geese, where depth of breast fleshing is desirable rather than excessive fatness. Ducks and geese should be well dressed and free from severe skin damage caused by excessive or poor scalding.

5. **Other Fowls**—Guinea fowl, squab and game birds will also freeze satisfactorily if well fattened, cleanly dressed and quickly chilled after dressing, then frozen.

Thin, poor quality fowls of any kind are not desirable for freezing.

PREPARATIONS

1. **Killing**—Chickens and turkeys may be killed in any one of several ways. A satisfactory and commonly used method involves bleeding by severance of the jugular veins followed by braining which involves piercing of the medulla or hind part of the brain. This latter is done either through the mouth or an eye. The accompanying illustration shows the details.

Thorough bleeding is important. Braining, if properly done, tends to loosen the feathers and facilitates plucking, even where slack scalding is practised instead of dry plucking. Turkeys are killed in a manner similar to that used for chickens.

Ducks and geese are commonly killed by severing the jugulars only. While braining is not so commonly done, it is practised by some. Others

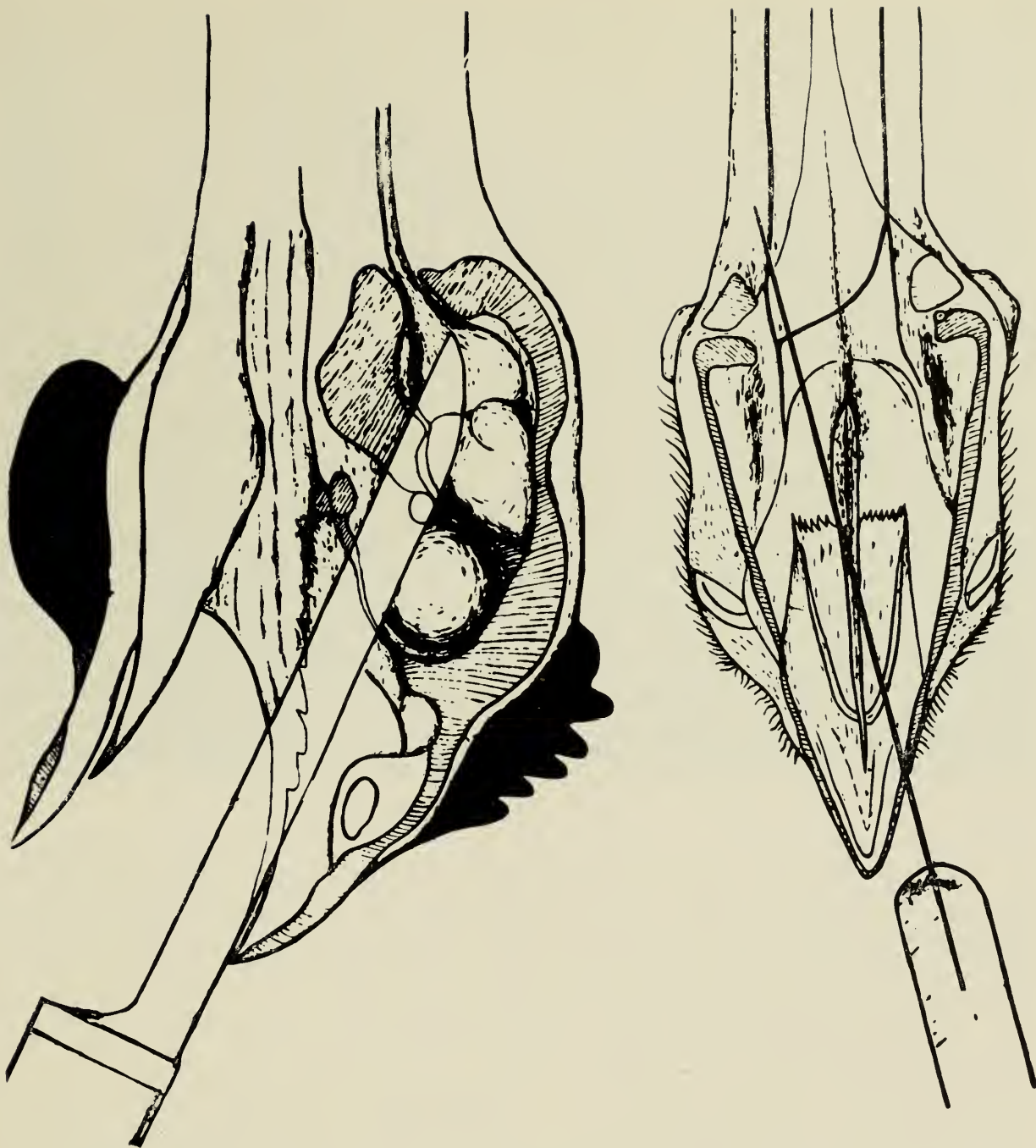


Fig. 5. The head of a fowl sectioned, showing placement of knife for bleeding and braining.

stun by striking the bird sharply with a stout stick on top of the head at the base of the brain. This serves the same purpose.

All fowls are suspended at a convenient height for killing, usually by means of some form of shackle. A weighted blood-cup attached to the beak by means of a hook serves to hold the bird's head down and catches the blood.

Another method is to place the bird to be killed, head downward, in a galvanized metal funnel with the bird's head protruding through an opening in the small end of the funnel. Such funnels may be fastened to a wall at a convenient height and several sizes serve for birds of various sizes and weights. Funnels are particularly useful for holding ducks and geese and may also be used for turkeys and chickens.

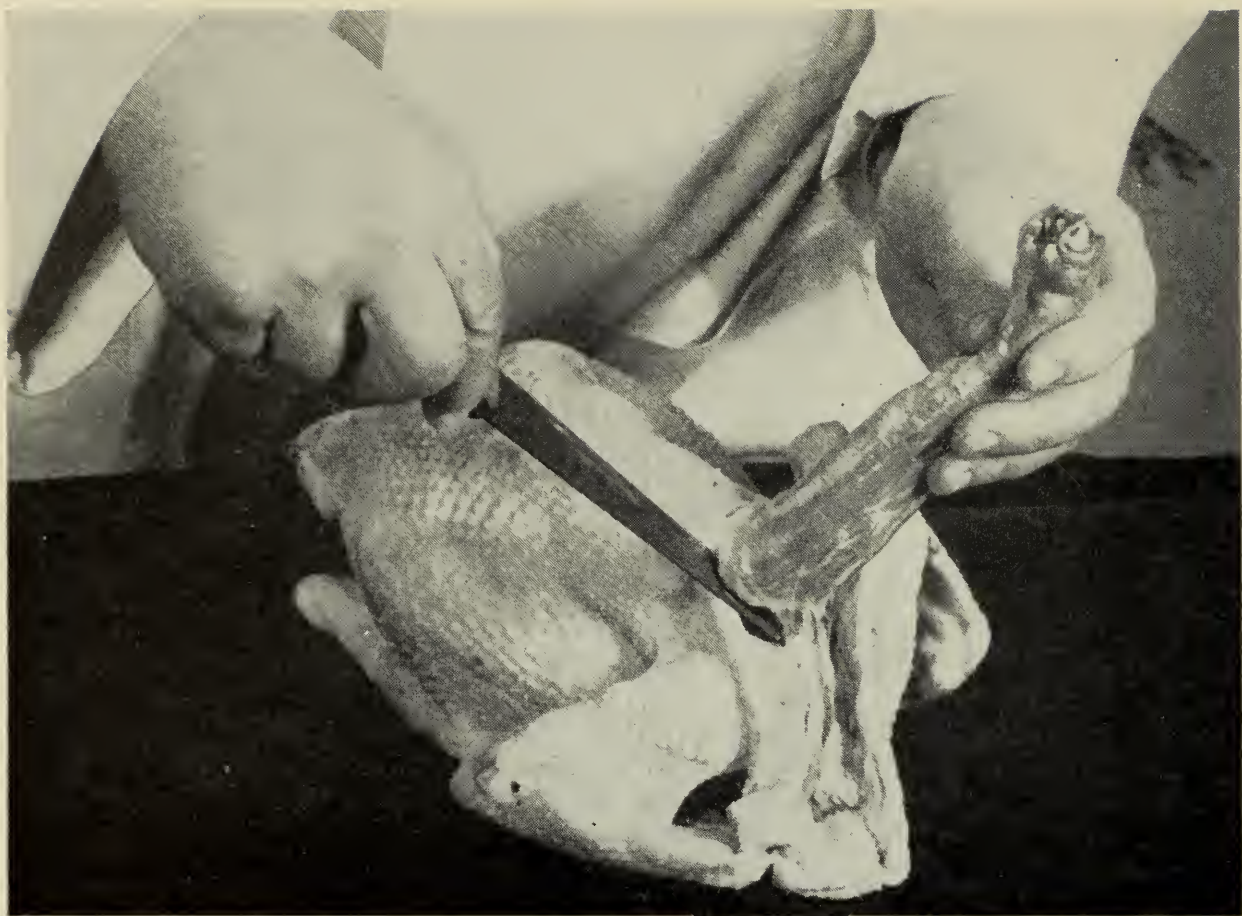


Fig. 6. The first step in drawing—removing the neck.

2. **Dressing**—All kinds of fowls may be plucked dry, though this is more difficult with ducks, and especially geese than with chickens and turkeys. However, a slack or soft scald makes plucking easier, especially where many pin feathers are present.

Water temperatures for slack scalding vary according to age of bird, size and length of immersion, as follows:

Kind	Age or Size	Temperature of Water	Time of Immersion
Broilers	2 to 4 lbs.	124-126° F.	30 seconds
Roasters	4 to 8 lbs.	126-128° F.	30 seconds
Fowl	cocks and hens	128-130° F.	30 seconds
Turkeys	young and prime	122-124° F.	30 seconds

Trial may indicate slight variations from these recommendations. Lower temperatures require longer immersion. Agitating the birds during scalding will aid in forcing the water through the feathers to the skin and so improve the uniformity of scald. A wash boiler will serve to hold the scald water. Scalding is most successful if performed immediately the bird is dead.

Ducks are best scalded in water at a temperature just under the boiling point and just long enough to loosen the feathers. Over or under-scalding results in "pocking", due to the unavoidable tearing out of small pieces of skin with the feathers during plucking. Geese may be similarly scalded, then wrapped in a sack or blanket for a few minutes to hold the heat in order to secure an even scald. Trial will indicate variations in time



Fig. 7. Circling of vent and vertical incision for removal of viscera.

required. Agitating the birds during scalding is an aid in getting the water through the feathers to the skin. This is particularly important with waterfowl because of their oily feathers.

Most birds require singeing to remove the fine hair-like feathers and down. Use of a gas flame or a flame from a blow torch will prove satisfactory for this purpose as a smokeless flame is required to prevent blackening of the skin. Excessive heat is to be avoided.

3. **Drawing**—Whether to draw birds before freezing is still a point of argument in the commercial freezing of poultry. In the opinion of the author, however, most housewives will find it convenient to freeze only drawn, clean birds. Drawn birds require special care in wrapping and packaging (see the section on “packaging”). Leaving the viscera in birds allows some chance of visceral flavour entering the meat. More important, perhaps, is the difficulty experienced in removing frozen viscera, or the delay necessary to thaw it, when a frozen bird is needed for the table.

Several methods may be used in drawing birds; through either a vertical or horizontal incision at the rear or, by splitting the bird up the back close to the backbone. The neck is first removed in either case by slitting the skin at the back of the neck to the shoulder then severing at this point. It is wrapped with the giblets. Removing the neck makes easy the removal of crop and windpipe (trachea). To draw from the rear, an incision is then made in the abdomen from the end of the breast to the vent and encircles this. The viscera are removed through this opening. Or the incision is made crosswise across the abdomen just behind the breast bone. A separate incision is used to encircle the vent, thus freeing the intestine and allowing the viscera to be removed through the horizontal incision.



Fig. 8. Circling of vent followed by horizontal incision.

To draw by splitting up the back, the skin is first slit open from shoulder to tail along the right side of the backbone. Stout kitchen shears or a small sized tinsmith's shears are used to cut along this line from tail to shoulder. A knife cut from the tail head to and encircling the vent makes possible the spreading apart of the severed bird for easy removal of the viscera, including lungs and kidneys. The oil gland on top of the tail is also carefully cut out and removed.

Be sure the lungs and kidneys are completely removed then wash the bird thoroughly and allow to drain before wrapping.

The clean giblets and the neck may be wrapped in waxed paper and inserted into the body cavity.

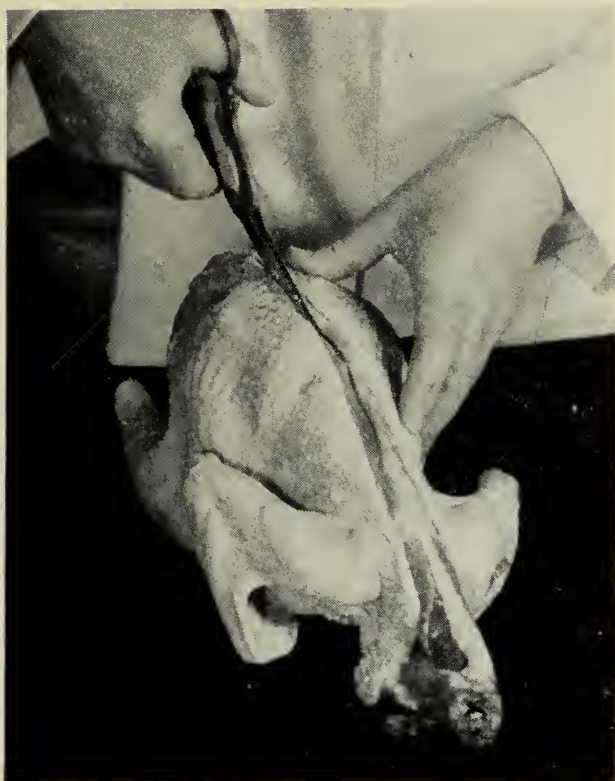
4. **Trussing**—Trussing of both unstuffed or stuffed birds improves the appearance and makes the carcass more compact.

The neck skin is drawn well down over the back and tied along with the wings tightly to the bird's body. In the split bird, the neck skin covers a considerable portion of the cut. The legs are then tied firmly to the tail head.

Where the horizontal incision is used, the legs may be inserted into this incision and out through the opening made for the removal of the vent. This serves to hold them tightly without tying.

5. **Stuffing Mixtures**—It would be a convenience if all roasting birds could be filled with a favourite stuffing mixture before freezing. **We have found that stuffing mixtures containing any of the following: bread

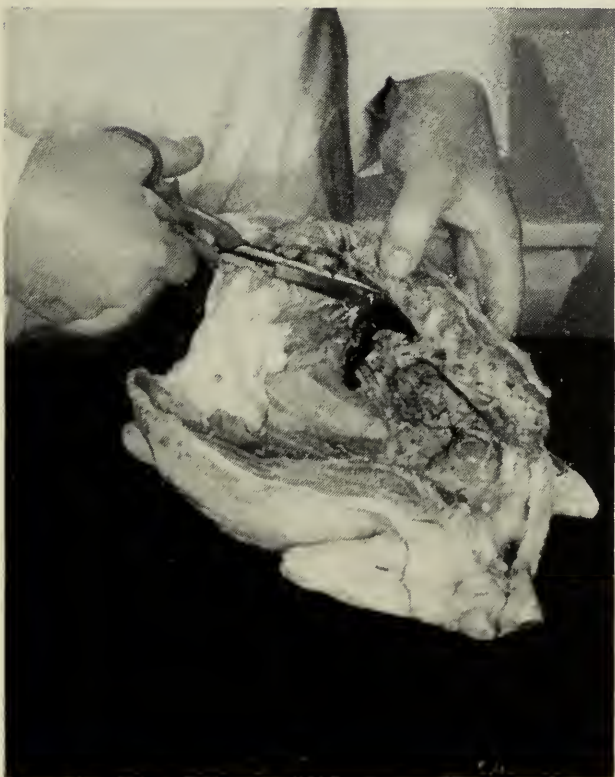
**Co-operative experiment by the author and Dr. Truscott.



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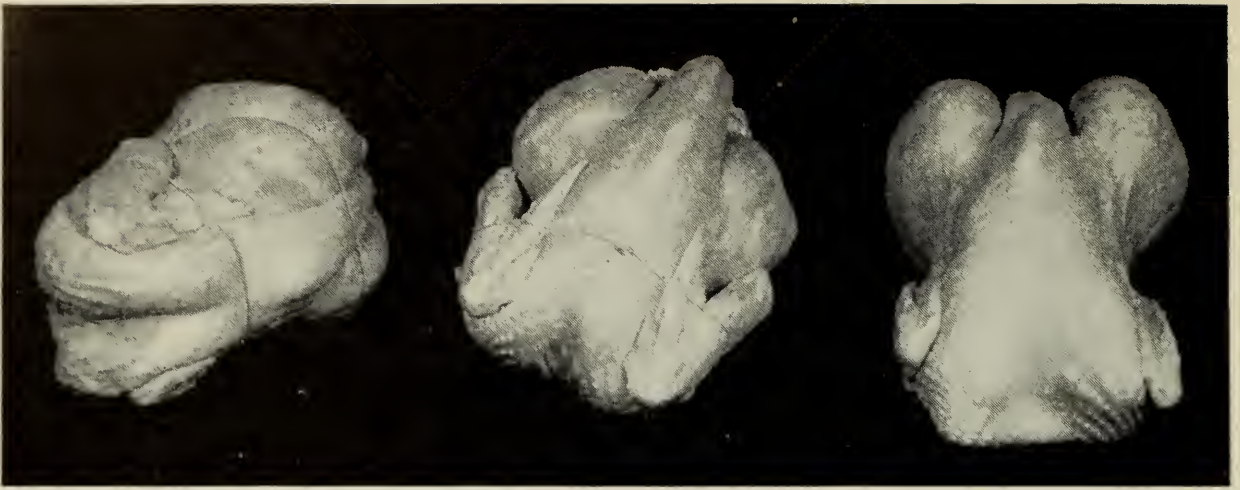


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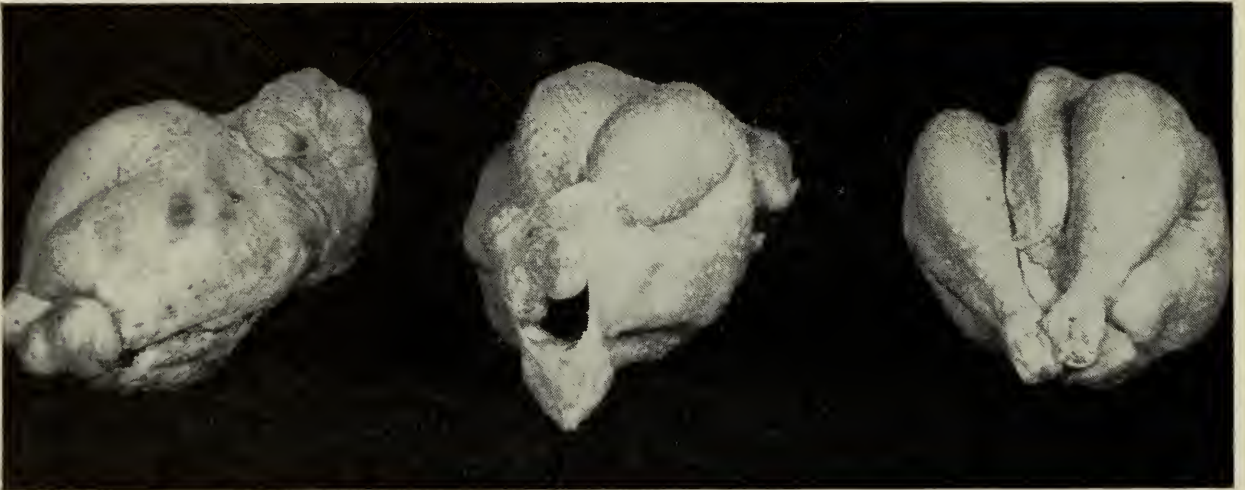
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Figs. 9, 10, 11 and 12. Steps in the drawing of a bird by splitting up the back.



Figs. 13 and 14. Front and rear views of three birds illustrating the three described methods of drawing. Left to right, split up the back, horizontal incision, vertical incision.



crumbs, mashed potatoes, a moderate amount of onion, chicken fat, sage, dried fruit, and salt, were reasonably good during a storage period up to 13 months.

Unfortunately some ingredients used commonly do not retain good quality when frozen. Our work indicates that pork sausage meat, chopped peanut and onion may give trouble. Pork sausage meat after 4 months of storage at 0° F. was quite inedible. Peanut in a dressing was rancid after 4 months storage, an onion flavour at the same time was too intense and somewhat off in flavour. Unexpectedly, all of the above ingredients improved with longer storage. After 13 months of storage, rancidity had disappeared from the nut stuffing mix, the onion flavour was nearly normal and the sausage meat was less offensive but still not palatable.

Most flavouring ingredients such as sage, were normal in flavour but the amount of flavour became less as the storage period increased.

We suggest that a favourite mixture be tasted in one or two birds after the stuffed birds have been in storage for 3 or 4 months. Even though the stuffing does not prove satisfactory, there is little loss since the flesh of the bird is not likely to be affected.

6. Fryers and Broilers—Considerable space is conserved in the freezer if broilers or fryers are cut up into serving pieces before freezing. Larger birds can also be halved or cut into smaller pieces before freezing. It is an effective space-saver with boiling fowl intended for pie or stew.



Fig. 15. A fryer cut up ready for the pan, packaged and frozen.



Fig. 16. A cut-up fowl showing the methods of cutting for stew, chicken pie, etc.



Fig. 17. Goose wrapped in cellophane, on a cradle used to prevent skin injury while wrapping.

PACKAGING OR WRAPPING

Good packaging or wrapping is necessary if frozen poultry is to retain good quality. Cut-up birds offer relatively little difficulty because the parts can be fitted tightly into rectangular packages of waxed cardboard, which, in turn can be readily wrapped in a suitable foil, film or waxed paper. Whole birds packaged singly are difficult to wrap effectively because of their uneven shape.

Effective packaging is necessary for several reasons: to keep the birds clean, to prevent contaminating flavours reaching them, and to prevent or reduce freezer-burn.

Freezer-burn is the name given to whitened areas surrounding the holes in the skin from which feathers were drawn. Excessive freezer-burn will cause the white patches to get larger to the point where they join into large unsightly masses. Moderate to slight freezer-burn may occur on even well-packaged birds and it does not appear to affect the flavour of the flesh. Moreover, it disappears during cooking. More severe freezer-burn results in impairment of flavour and texture or excessive weight loss from the birds. It is caused by the evaporation of water from the bird. Drawn birds are especially affected since more tissue is exposed.

Reference should be made to page 5 on wraps and packaging. We find that a cellulose or rubber film, heat-sealed, followed by butcher's paper or other strong, water-resistant paper is a good package for whole birds. Regardless of the wrapping used, it is essential that great care be exercised to leave as little air space as possible around the bird and to see that all joints in the wrap are sealed by foldings or other means.



Fig. 18. Cellophane-wrapped goose covered with stockinette to protect the cellophane from tears during handling and storage in freezer.

A plastic material applied by dipping the bird into the melted plastics is on the market. We do not have first-hand experience with it and we can make no comment other than that the equipment necessary is rather costly for home use. Some locker plants have such equipment and charge according to the weight of the bird to be coated. No other covering is said to be necessary.

Cut-up birds are most conveniently packaged in rectangular, waxed, cardboard containers. (See Fig. 15.) Preferably, use an inner lining of foil or film, and seal the outside of the box with an overwrap of suitable material.



Fig. 19. Chicken showing moderate freezer-burn.



Fig. 20. Fairly satisfactory results follow close double wrapping of a fowl with a good wax-coated paper.

COOLING

Poultry should be cooled for about 24 hours, at from 32-34° F., if possible, before packaging and freezing. Most people do not like the flavour changes resulting from hanging birds to age the meat. Following packaging, the birds should be frozen as quickly as possible. The chief importance of quick freezing in poultry is that an arrangement that provides *quicker freezing* automatically gives *quicker cooling*. It is important that the temperature of the bird be reduced so quickly that molds have no chance to develop. A well-wrapped roasting chicken may require 24 to 48 hours to freeze to the centre in a blast of 0° F. air. If several birds are piled together the freezing time is increased. Most of the birds sent here for examination because of unsatisfactory condition, have been affected by mold growth. In most instances the mold must have grown in the interval between packaging and freezing.

Locker plants are required to hold 0° F. or lower in both the freezing compartment and the locker room. Those using home freezers should place the birds in contact with a cold surface in the box. The holding temperature should not be above 0° F., partially because there are likely to be other foods in the box that must be held at 0° F. or lower. Even with poultry, however, a group of persons here were unable to distinguish chicken held for 13 months at 10° F. from those held at 0° F. for the same length of time. There was no detectable depreciation of flavour in chicken held 13 months at 0° F.

COOKING FROZEN POULTRY

There is some difference of opinion as to whether poultry should be thawed before cooking. Obviously an undrawn bird must be at least partially thawed before the viscera can be removed or, a drawn bird may require some thawing before it can be stuffed. If, however, a bird is ready for the oven, or if cut-up pieces are to be fried, broiled or boiled, cooking

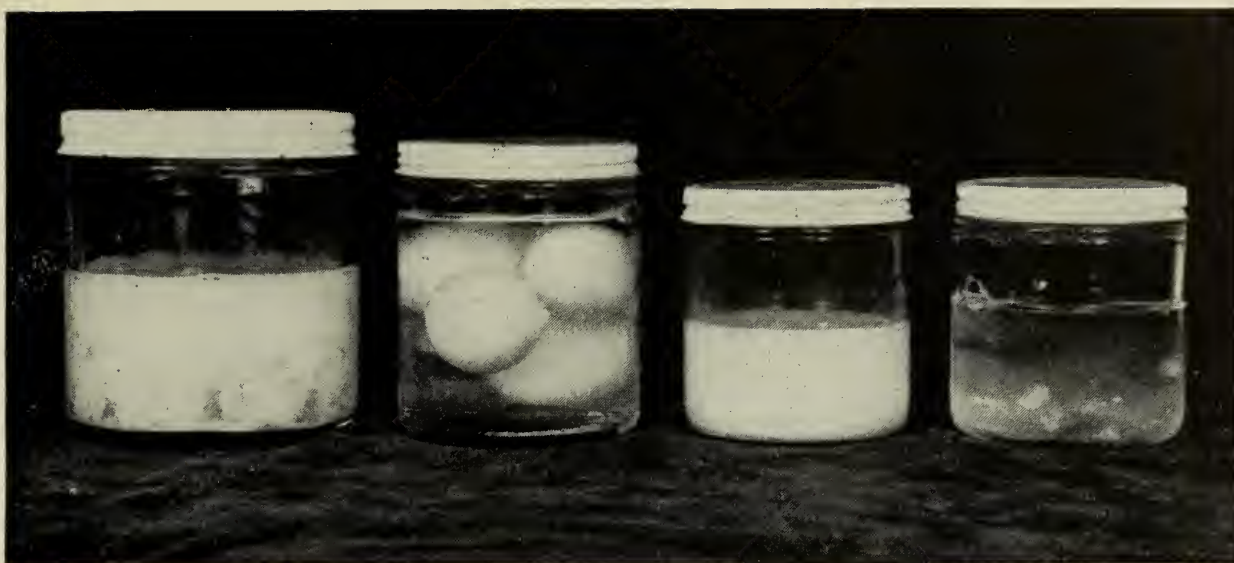


Fig. 21. Whole eggs, yolks and whites, may be successfully frozen if first slightly beaten. Whole yolks tend to partially solidify. Left to right, whole eggs beaten, whole egg, egg yolks beaten, egg white whole.

can commence when the flesh is frozen. According to our experiments the cooked flesh was indistinguishable regardless of whether the flesh was thawed or frozen when cooking began. It may be necessary to increase the cooking time somewhat when starting with frozen flesh. A thawed bird may be slightly more susceptible to bacterial attack than a fresh-killed bird but there isn't an important difference from the housewife's standpoint. It is always good practice to handle both thawed and so-called "fresh" birds quickly as both are very perishable.

Poultry may be cooked before freezing. The flesh kept in excellent condition for 13 months at 0° F. according to our observations. Stuffing mixtures behaved in a manner similar to that in uncooked birds (see page 28).

MISCELLANEOUS POULTRY PRODUCTS

(1) **Chicken preparations** such as **Chicken a la King** and **Chicken Pie** have been frozen successfully. It is suggested that the housewife test favourite preparations after freezing. It would be advisable not to attempt holding such preparations longer than 4 months unless it is known that a particular mixture will hold longer than that.

(2) **Turkey "steaks"**—There is considerable interest in turkey meat prepared by machines that form pieces of meat into shaped flat "steaks". These may be of either white or dark meat and are usually 4 oz. in size with a little fat included for flavour. Considerable attention to sanitation is advisable in their preparation and each steak is best enclosed in a small, heat-sealed, cellophane bag. After immediate freezing, a number of steaks may be packed in a suitable container for further storage.

(3) **Giblets**—Chicken hearts, livers and gizzards in appropriate packages remained in excellent condition for 13 months at 0° F.

(4) **Eggs**—Egg shells crack when whole eggs are frozen and the yolks become gummy and partly solid when held. Separated egg white may be frozen in such containers as paper cups. Yolks or mixtures of yolk and white should have about a tablespoon of syrup or sugar stirred into each 2 cups of mixed egg. The mixture may then be divided into paper cups in the quantity needed for a cake, etc.

SECTION IV

MEAT FOR THE LOCKER

By E. C. STILLWELL

Freezing meats under controlled methods of modern refrigeration is a great convenience. This is very evident in country districts remote from retail meat markets and also at certain times of the year when the natural temperature forbids the slaughtering of animals unless mechanical refrigeration is available. The use of freezing storage has added greatly to the variety of the meat diet in many homes, as well as keeping the family budget down.

KINDS OF MEAT

Beef, pork, lamb and veal are the meats most commonly frozen although at certain seasons of the year game may be added to the diet. It is well to avoid extremes in finish, that is, meat from animals which are too fat, as the fat oxidizes and rancid flavours result, and if the fat is trimmed off it adds to the cost. Meat from very thin animals might be so lacking in fat that it would lack flavour and palatability. Carcasses from healthy meat producing animals, in a reasonable degree of finish, are preferable to those from non meat producing and in poor flesh. Beef and pork are at the top of the list in kinds of meat frozen.

PREPARATION

Animals, for meat, may be slaughtered on the farm or, if the facilities are available, at the storage plant. Feed should be withheld from the animals for eighteen to twenty-four hours before slaughtering, but water should be available. A quick job of killing and a clean job of dressing should be the main points to remember.

COOLING

Carcasses which are properly cooled are much easier to cut because they are firm. Soft flabby meat which has not been properly chilled will result in ragged unsightly cuts. The ideal temperatures for cooling should be between 33° F. and 38° F. If temperatures can not be controlled the animals may be killed in the evening and get the benefit of the cold night air provided it does not go below the freezing point. In extremely cold weather carcasses should be hung in a sheltered place to avoid freezing. In any case carcasses should be properly cooled out before cutting.

RIPENING

It is not necessary to ripen carcasses from young animals, that is approximately one year old. Meat from older animals if held at temperatures 33° F. to 38° F. for two weeks will break down the tissues and make the meat more tender. It is true, freezing also has a tendency to tenderize. If the meat is held for too long a time, the outside of the carcass becomes discoloured and mouldy; this will have to be trimmed which adds to costs. Baby beef and lamb require very little ripening. The following timetable is suggested for ripening or holding carcasses:

Beef—good and choice	-	-	-	-	2 weeks
medium and common	-	-	-	-	1 week
Lamb—good and choice	-	-	-	-	1 week
Pork	-	-	-	-	3 to 4 days
Veal	-	-	-	-	24 hours

CUTTING

The cutting of meat varies with the storage plants. Some processors cut to suit the wishes of the customers, others have one method and follow this only.

There is the retail style, giving a large number of steaks and roasts.

There is the system of cutting to suit the wishes of the consumer.

Possibly the most important point to keep in mind is to cut into pieces to suit the size of the family.

In many plants the electric meat cutter or power saw is a necessity to keep costs down to a minimum. Considerable care must be exercised by the operator of the saw to get best results. Too often a good saw is ruined and then condemned by an unskilled operator. Another point that needs attention is cleanliness. A good operator will take pride not only in his workmanship but in keeping the machine clean.

BONING AND ROLLING

The boning and rolling of meat has many advantages:

1. Conserves space in the locker, a saving generally of 25 per cent but 50 per cent in the case of lamb.
2. Less dehydration and oxidation due to tight packaging. When the bone is left in, the paper tears, leaving open spaces and air pockets.
3. The meat can be sliced and served much more readily.
4. The meat can be cut into pieces and packaged to suit the size of the family.
5. The bones can be used for Soup stock.

The disadvantages of boning are:

1. The boning takes time. This increases the cost.

WRAPPING

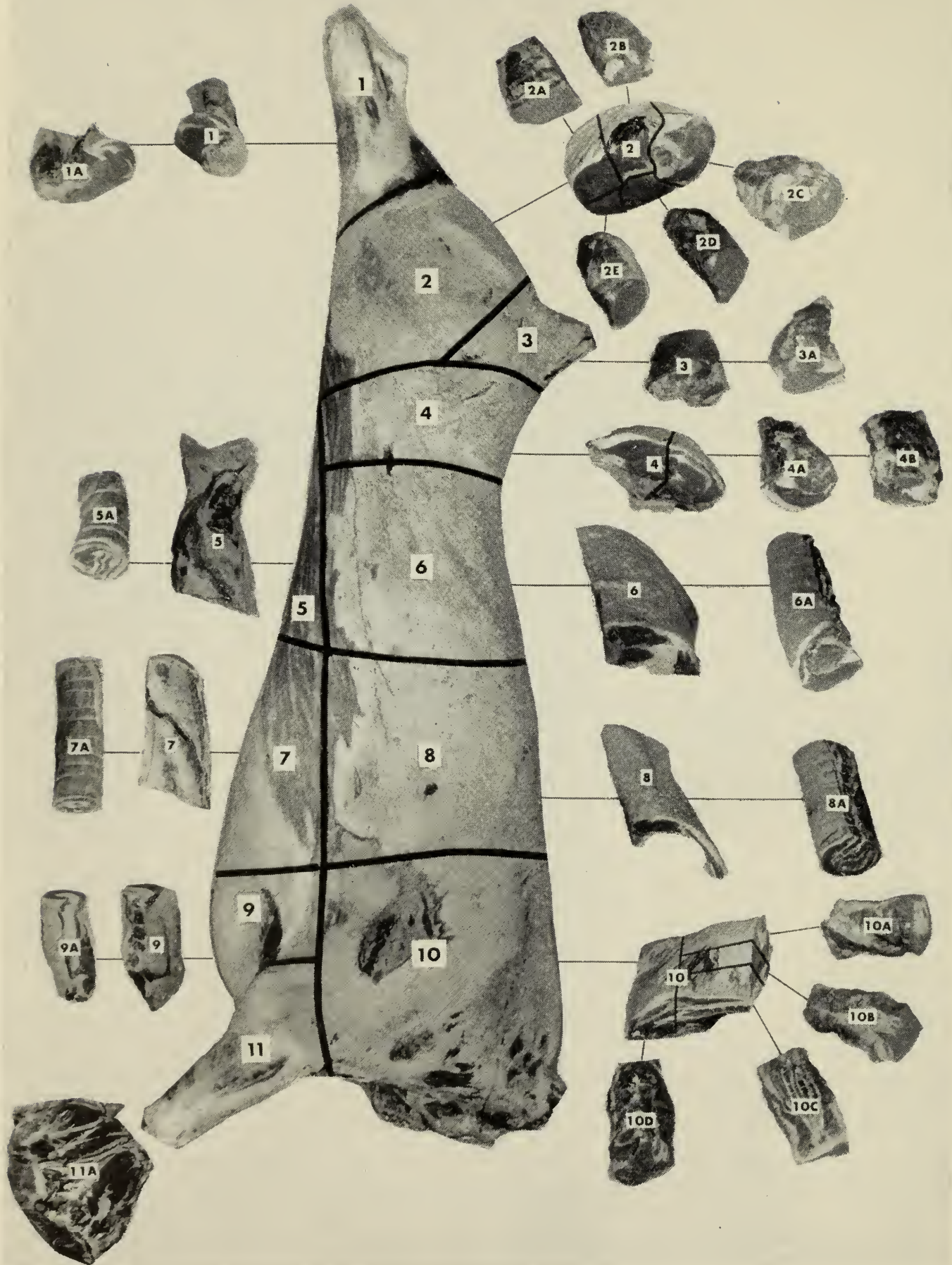
The main thing to remember when wrapping meat is to do it in such a way that air pockets are eliminated. Waxed paper placed about the meat in either drug store wrap or butcher's wrap and tied securely is popular. There are other materials such as cellophane, pliofilm, available which are moisture and vapour proof.

THAWING AND COOKING

It is optional whether meat is thawed before it is put on to cook or not. Convenience is generally the deciding factor. No matter what method is used a meat thermometer is desirable for accuracy.

Although freezing meat may have some tenderizing effect, it is well to remember that the less tender cuts must still be cooked as such, that is lower temperatures and longer time. The tender cuts such as steaks can still be cooked in the same way as those methods recommended for unfrozen meats, of similar quality.

BEEF



LENGTH OF STORAGE

	Zero Temperature	15° below Zero
Pork	Average condition—4 months	Increase several months
Beef	Average condition—8 months	Increase several months
Veal	Average condition—8 months	Increase several months
Lamb	Average condition—8 months	Increase several months

The following illustrates about what yields are expected when meat producing animals are processed:

BEEF

Beef steer—880 pounds live weight.

Warm dressed weight	532 pounds	60.4%
Cold dressed weight (18 days in the cooler)	509 pounds	57.8%
Shrinkage	23 pounds	2.6%
Liver	10½ pounds	
Tongue	4½ pounds	
Heart	4 pounds	
Hide	70 pounds	

It must be remembered that dressing percentage varies with age, weight, fill, condition, quality. A poorly finished beef animal will dress out 50 per cent or even lower while a well finished prime beef steer will dress out 60 per cent or more.

The usual practice in cutting beef is to first, quarter the sides into front and hind, eleven ribs in the front quarter and two in the hind.

As has been mentioned there are various ways of processing meat for the locker but the following illustrates a method which will make the cuts into sizes to suit the family needs. In the following tables the numbers given represent the large wholesale cuts while the numbers with a letter added are the finished cuts.

Illustrations—Courtesy Public Relations Department, Ontario Agricultural College.

BEEF. HIND QUARTER 125 ¼ LBS.

No. Wholesale Cut	Weight	Weight Boneless	Weight of Bone	Use of Cut
1. Hind Shank	11 lbs. (1A)	6¼ lbs.	4¾ lbs.	Soup Stew Pot Roast Ground meat
2. Round	43½ lbs.	40 lbs. 2A. 7 lbs. 2B. 7 lbs. 2C. 9 lbs. 2D. 9 lbs. 2E. 8 lbs. — 40 lbs.	3½ lbs.	Steaks Roast
3. Rump	10 lbs. (3A)	7 lbs.	3 lbs.	Roast
4. Loin End	21 lbs.	14 lbs. 4A. 7 lbs. 4B. 7 lbs. — 14 lbs.	3 lbs.	Steaks Roast
5. Flank	15½ lbs. (5A)	8 lbs.	½ lb.	Flank steak Stew Ground meat
6. Short Loin Kidney & Fat	18¼ lbs. (6A) 6 lbs.	13¾ lbs.	3 lbs.	Steaks Roast

Boneless Meat	89 lbs.
Bones	17¾ lbs.
Fat & Kidney	15¼ lbs.
Trimmings	3¼ lbs.
	125¼ lbs.

BEEF. FRONT QUARTER 129 LBS.

No. Wholesale Cut	Weight	Weight Boneless	Weight of Bone	Use of Cut
7. Plate	21 lbs. (7A)	16½ lbs.	3 lbs.	Pot roast Stew Ground meat
8. Prime Rib	19¾ lbs. (8A)	14 lbs.	5 lbs.	Roast Steaks
9. Brisket	11¼ lbs. (9A)	8 lbs.	2¼ lbs.	Pot roast Stew
10. Chuck (4 Ribs)	66½ lbs.	48½ lbs.	12½ lbs.	Roast Pot roast Stew
	10A. 9 lbs.			
	10B. 10 lbs.			
	10C. 9½ lbs.			
	10D. 20 lbs.			
		48½ lbs.		
11. Fore Shank	10½ lbs. (11A)	6 lbs.	3¾ lbs.	Soup Stew Ground meat
Boneless Meat				93 lbs.
Bones				26½ lbs.
Fat				2½ lbs.
Trimnings				7 lbs.
				129 lbs.

SIDE OF BEEF 254¼ LBS.		
Boneless Meat	182 lbs.	— 71.5%
Bones	44¼ lbs.	— 17.3%
Fat & Kidney	17¾ lbs.	— 6.7%
Trimnings	10¼ lbs.	— 4.0%
	254¼ lbs.	99.5%

VEAL

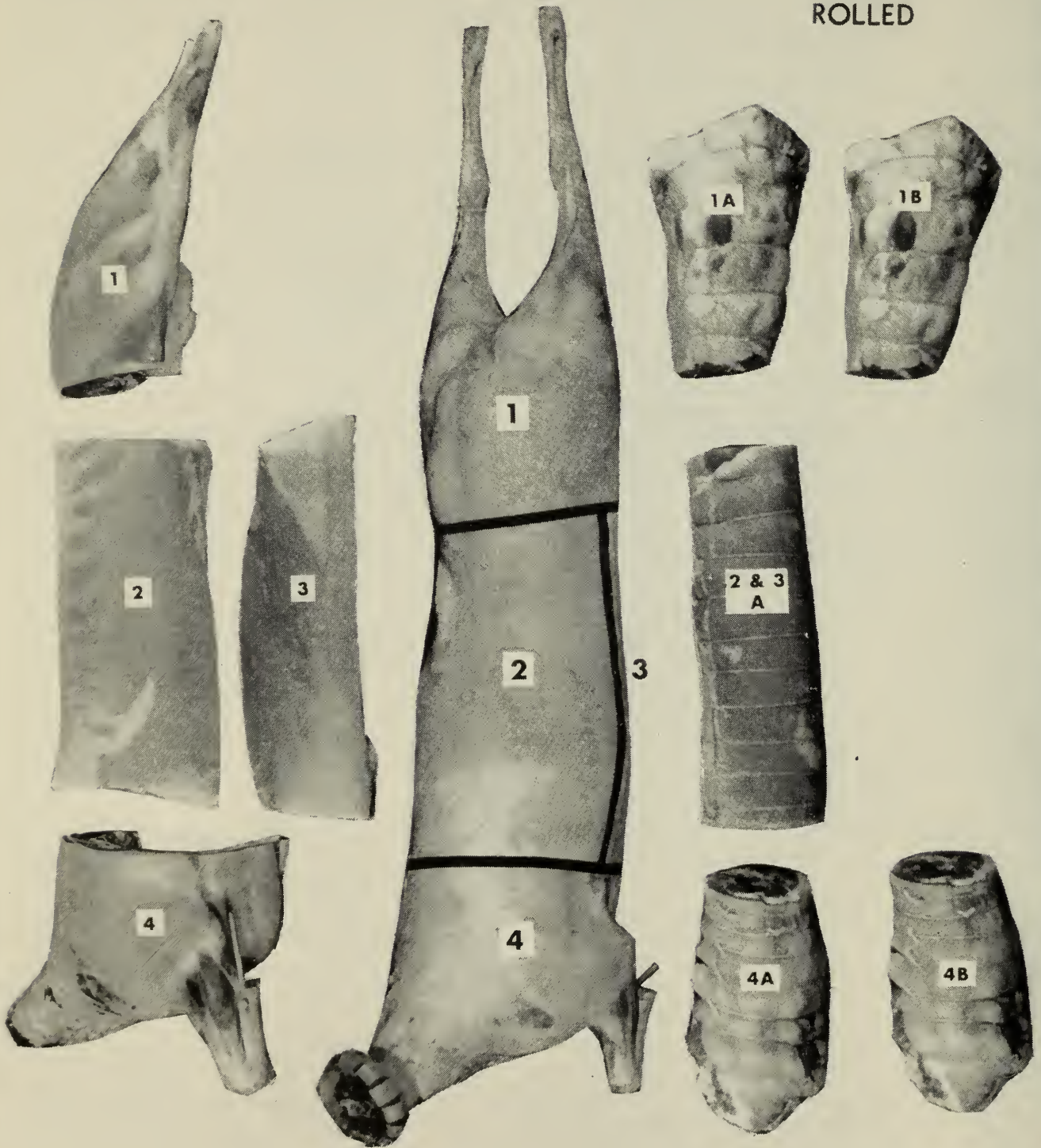
Veal runs very high in moisture. A calf 200 pounds in weight will have about 70 per cent moisture while, in contrast, a 1000 pound steer will be about 52 per cent moisture.

When veal is prepared for the locker similar methods can be used as for beef. The cuts, of course, will be much smaller and due to the moisture content it is much more difficult to get a neat job of boning and rolling.

LAMB

UNTRIMMED

BONED
AND
ROLLED



LAMB

Lambs in good condition should dress out 50 per cent or better depending on fleshing and quality. If a good job is done on the dressing of lamb an attractive carcass results which can be cut up into sizable pieces for the family table. The following is one method of cutting which gets the maximum use of the locker space.

L A M B . 4 0 L B . C A R C A S S

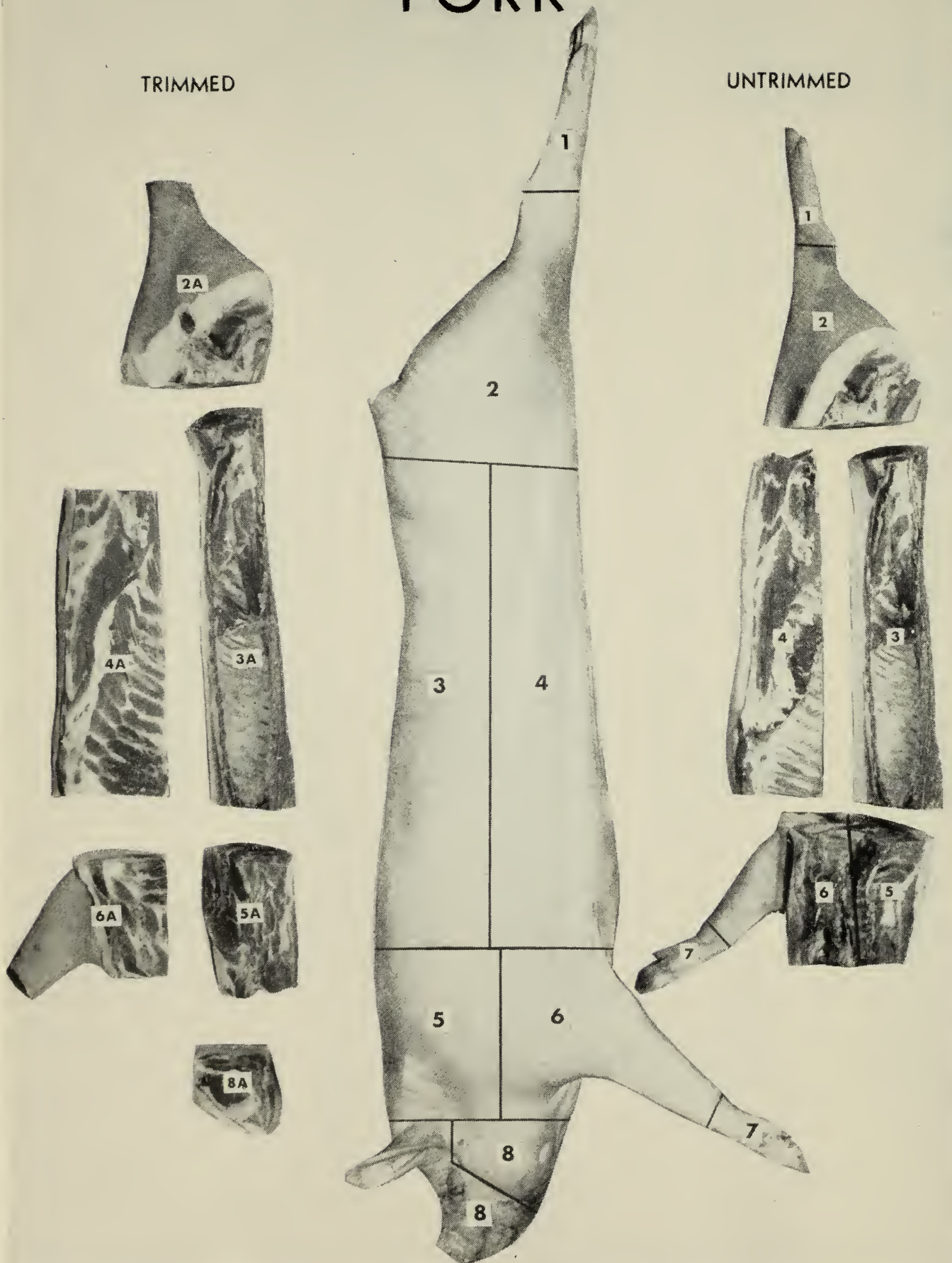
No. Wholesale Cut	Weight	Weight Boneless	Weight of Bone	Use of Cut
1. Leg	12 lbs. 8 ozs.	9 lbs. 2 ozs. 1A. 4 lbs. 8 ozs. 1B. 4 lbs. 10 ozs.	3 lbs. 6 ozs.	Roast
2. } Loin 3. } Flank	11 lbs. 8 ozs.	9 lbs. 2 & 3A. 9 lbs.	2 lbs. 8 ozs.	Roast Chops Stew
4. Front	13 lbs. 10 ozs.	10 lbs. 10 ozs. 4A. 5 lbs. 4B. 5 lbs. 10 ozs.	3 lbs.	Roast Chops Stew
Kidney & Fat		2 lbs. 6 ozs.		

Boneless Meat		28 lbs. 12 ozs.—71.88%
Bones		8 lbs. 14 ozs.—22.20%
Fat & Scrap		2 lbs. 6 ozs.— 5.92%

PORK

TRIMMED

UNTRIMMED



PORK

A great many pigs are slaughtered for home use, part of the meat being cured while the rest is used fresh. Fresh pork should not remain in the lockers more than four to six months on the average. As far as cured pork is concerned, the curing process was used in the first place to add to the keeping qualities of the meat and the length of time in the lockers is greatly increased over that of fresh pork. In some cases, however, some locker operators do not encourage the storage of smoked meats due to the odour of the smoke. However, that is a matter for the operator to decide.

Sausages may be stored in the locker but the salt should be left out of the seasoning to safe guard the product.

Bacon type pigs in the regular marketing weights, around 200 pounds, will dress out about 75 per cent.

In the illustrations and the tabulated cuts and weights, it must be remembered that only one-half of the carcass is illustrated but, both sides are represented in the weights.

PORK. 168 LB. CARCASS

No.	Wholesale Cut	Weight	Weight Trimmed	Bones	Use of Cut
1. {	Hind Foot				
2. }	Ham	38 lbs.	2A. 31 lbs. 2 ozs.	2A.	Steaks Roast
3.	Back	40 lbs. 2 ozs.	*3A. 29 lbs. 12 ozs.		Chops Roast
4.	Belly	29 lbs. 10 ozs.	**4A. 17 lbs. 14 ozs.	5 lbs. Spare Ribs	Bacon
5.					Chops
6.	Shoulder	41 lbs.			Roast
7.			5A. Butts 15 lbs. 14 ozs. 5 lbs. 4 oz.		
			6A. Picnics 17 lbs. 2 ozs. Neck Bones		
1 & 7 Feet 4 lbs. 10 ozs.					
8.	Head	15 lbs. 4 ozs.	8A. Jowl 4 lbs. 4 ozs.	10 lbs.	Bacon squares
Leaf Lard 4 lbs.					
Trimmed Meat 116 lbs.					
Fat & Trimmings 26 lbs. 2 ozs.					
Bones 21 lbs. 4 ozs.					
Feet 4 lbs. 10 ozs.					
168 lbs.					
MEAT BONED AND ROLLED					
Boneless Meat 90 lbs.					
Bones 25 lbs.					
Head 10 lbs.					
Feet 4 lbs. 10 ozs.					
Fat for lard 26 lbs.					
Trimmings 12 lbs. 6 ozs.					
168 lbs.					
*3A. Loin					
**4A. Bacon					

CARONAF
B468

CANNING ONTARIO'S FRUITS AND VEGETABLES



ONTARIO DEPARTMENT OF AGRICULTURE
STATISTICS AND PUBLICATIONS BRANCH TORONTO

BULLETIN 468

AUGUST 1949

FAMILY GARDENS FOR TOWN AND COUNTRY



USE GARDEN FRESH FRUITS AND VEGETABLES
FOR CANNING

CANNING ONTARIO'S FRUITS AND VEGETABLES

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PREPARED BY

**THE WOMEN'S INSTITUTE BRANCH
AND HOME ECONOMICS SERVICE**

ONTARIO DEPARTMENT OF AGRICULTURE

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CANNING METHODS



The microscope reveals these causes of food spoilage: (top) moulds, (centre) yeasts, (bottom) bacteria.

WHY FOOD SPOILS

Food is spoiled by invisible organisms. The presence of these organisms is revealed under a microscope. We should never doubt their presence because we cannot see them! They are present everywhere—in soil, on fruits and vegetables, on our hands and kitchen equipment, and in the air. They are of three types: moulds, yeasts and bacteria. If allowed to live and grow in fruits and vegetables, these organisms will cause spoilage.

Besides moulds, yeasts and bacteria, all fruits and vegetables contain chemical substances, called enzymes. Enzymes have many functions and are responsible for the ripening of fruits and vegetables. If the action of enzymes is allowed to continue, spoilage will result.

WHY CANNING MAKES FOOD KEEP

For canning, by approved methods, food is placed in clean containers. Then these containers are heated until their contents have been kept at a **sufficiently high temperature for a sufficient length of time** to stop the action of enzymes and kill all organisms. Food may be heated or processed in a boiling water bath, an oven with an automatic heat control or a pressure canner. The necessary precautions are taken to ensure that no organisms can enter the containers after the heating or processing is completed.

Another method of canning is called the **open kettle method**. Food, cooked in an open kettle, is placed in sterilized sealers. The sealers are filled to overflowing, closed, cooled and stored. This method is not generally recommended for fruits and never for vegetables. It is used less today than in days-gone-by because spoilage more frequently results from this old-time way of canning. Because of the large quantities of sugar used, the open kettle method is satisfactory for jams and jellies. It is also satisfactory for pickles.

WHY THE PRESSURE CANNER IS RECOMMENDED FOR ALL VEGETABLES EXCEPT TOMATOES



Food may be heated to a higher temperature in a pressure canner than in a boiling water bath or oven. This higher temperature which can be reached in the pressure canner is necessary to **ensure** complete destruction of bacteria in vegetables other than tomatoes. A vegetable, processed for a long period of time in a boiling water bath, may keep without spoilage. But spoilage is **always** a possibility when the boiling water bath is used.

Canned vegetables with a bad odour or appearance should be discarded without tasting. Never feed questionable food to chickens or animals. It is dangerous to them too. Such food should be burned and the glass sealer in which it was packed, along with the glass cover, should be boiled in a solution of lye. Safely dispose of rubber rings and metal tops from jars of questionable or spoiled vegetables.

Unfortunately, signs of spoilage due to bacteria in canned vegetables are occasionally not evident. Eating such food may cause illness or death. Even though they appear wholesome, vegetables processed in a boiling water bath should be boiled for ten minutes in an uncovered saucepan before they are tasted. ***Never taste to discover spoilage!***



Home canned vegetables (except tomatoes) processed in a boiling water bath, are boiled ten minutes before tasting.



QUANTITIES FOR CANNING

HOW MUCH SHOULD YOU CAN ?



Can, each year, the quantity of food which your family will require. Have a canning plan and avoid surpluses and shortages.

It is unwise to can more than the quantity of food which you expect to require during the following year. Although perfectly canned food will keep indefinitely, quality may deteriorate after twelve months. Canning less than your requirements may result in higher food expenditures in the spring months or in doing without a liberal supply of fruits and vegetables. Can generous quantities of tomatoes and tomato juice. A large serving of tomatoes can substitute for your daily citrus fruit requirement. Although yearly crop and market conditions may alter your plans, it is good policy to estimate the quantities of each food you intend to "put up" before commencement of the canning season. Such a plan tends to reduce year-end surpluses of some canned foods and inadequate supplies of others.

CHART I

APPROXIMATE YIELD OF CANNED PRODUCTS FROM RAW FOOD

A guide to the quantity of raw food which you will require for your canning is given by these charts.

FRUITS

Fruit	Quantity raw fruit	Approximate yield as canned product
Apples	1 6-qt. basket	3-4 qt.
Blueberries	1 6-qt. basket	6 qt.
Cherries	1 6-qt. basket	4-5 qt.
Crabapples	1 6-qt. basket	4 qt.
Peaches Pears Plums	1 6-qt. basket (level)	5 qt.
Raspberries	1 qt. box	1 qt.
Rhubarb	2 qt. diced or 3 lb.	1 qt.
Strawberries	4 qt. boxes	3 qt.
Thimbleberries	1 qt. box	1 qt.
Tomatoes	1 11-qt. basket or 20 lb.	7 qt.

VEGETABLES

Vegetable	Quantity raw vegetable	Approximate yield as canned product
Asparagus	1 11-qt. basket or 11 lb.	7 pt.*
Beans— Green or Wax	1 6-qt. basket or 6 lb.	7 pt.*
Beets Carrots	1 6-qt. basket or 9 lb.	7 pt.*
Corn—Golden Bantam	3 doz. ears	7 pt.*
Greens	½ bu. (16 qt.) or 9 lb.	7 pt.*
Peas (in pod)	9 qt.	7 pt.*
Tomatoes	See Fruit Chart (above)	

*The pressure canner is recommended for canning vegetables except tomatoes. The capacity of the pressure canner in common use is seven pints.

STEPS IN CANNING

UNDERSTAND THE RULES

Like any game, canning has its rules. You must understand the rules of a game **before** you start to play. You must understand directions for canning **before** you start to can. Read and understand reliable directions for the complete canning process of the particular food you have on hand. **Then abide by the rules.** Penalties for breaking canning rules are often costly.

ASSEMBLE ALL EQUIPMENT

Speed is important in canning. To reduce to a minimum the interval of time between the gathering of your food and the completion of canning, check and conveniently assemble all equipment in advance. Your foresight will be rewarded by better canned food on your shelves.



CANNING EQUIPMENT

The essential equipment for canning is found in most households. As her budget permits, the homemaker is advised to replace out-of-date equipment and buy the tools which make canning speedier, more efficient and more enjoyable:

ASSEMBLE CONTAINERS

Containers for home canning are glass sealers and tin cans.

GLASS SEALERS

of several types are in use in Ontario:

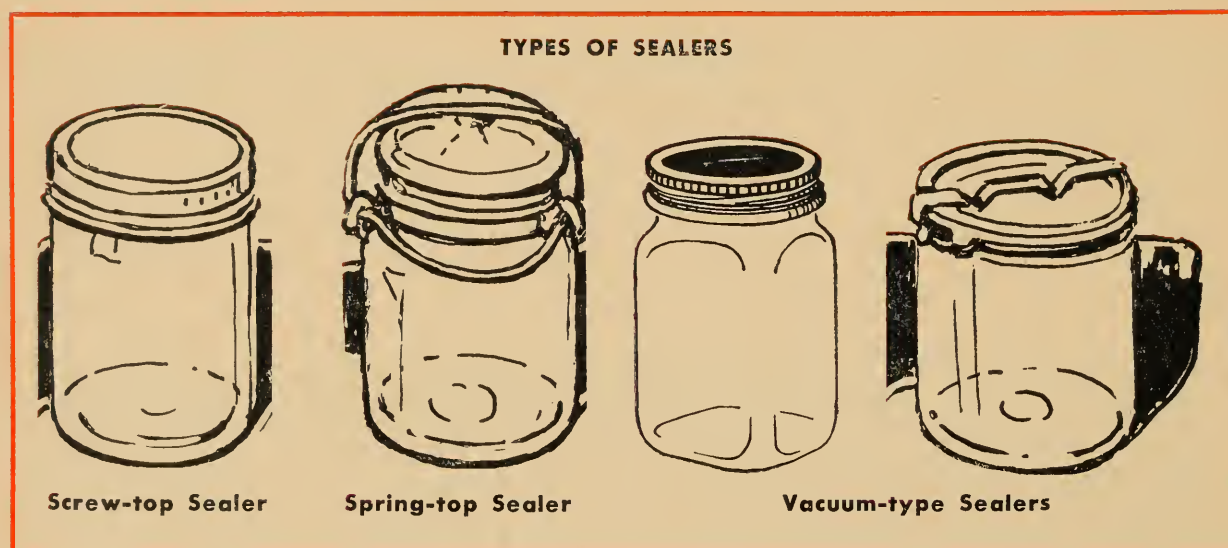
SCREW-TOP SEALERS with glass lid, rubber ring and metal screw band.

SPRING-TOP SEALERS with glass lid, rubber ring and wire bails.

VACUUM-TYPE SEALERS

(1) With metal lid edged with sealing compound and metal screw band.

(2) With glass lid, rubber ring and metal clamp.



Jars in which pickles, peanut butter, mayonnaise and other commercial products are sold make suitable containers for jams, jellies and pickles only.

TIN CANS

of three types are in use in Ontario:

PLAIN CAN is tinned on inside and outside. *It is a general purpose can which should be used for any food which does not discolour in presence of the tin lining.* Use plain cans for tomatoes and tomato juice.

R OR STANDARD OR SANITARY ENAMEL CAN is coated inside with a bright, deep gold enamel. It is specially designed to retain the natural colour of red berries, cherries, red plums, rhubarb and beets.

C-ENAMEL CAN is coated with light gold enamel to prevent discolouration in corn. Do not use for fruits or tomatoes.

SIZE OF CONTAINERS

Use the size of container that suits your family. Never use two-quart jars for packing non-acid foods. No. 2 (20 ounces) and No. 2½ (28 ounces) are the sizes of cans most commonly used in the home.

NUMBER OF CONTAINERS

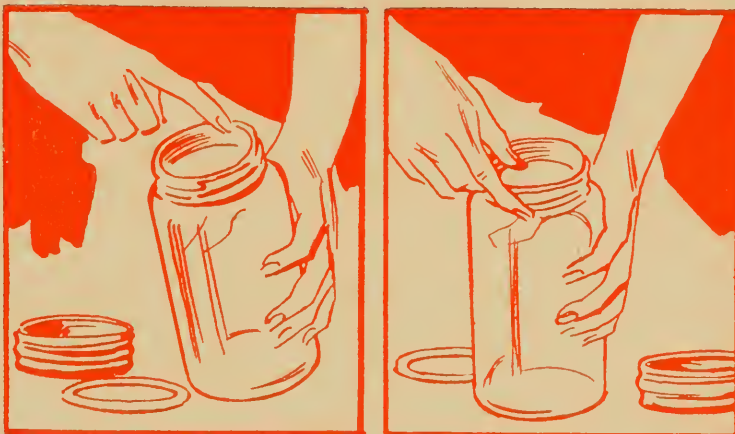
To estimate the number of containers required, consult Chart I, page 6.

CHECK CONTAINERS

Since organisms causing food spoilage are present in the air, only containers which can be made completely airtight are useful for canning. Advanced checking of containers prevents waste of food and time.

GLASS SEALERS

1. Examine each jar and glass lid for cracks and chips. Discard damaged equipment.
2. Examine each metal screw band for corrosion, cracks, dents and signs of wear. Wire bails on spring-top sealers should spring into position with a snap. Discard damaged equipment which is not repairable.



Check top of sealers, on inside and outside, and glass lids for cracks and chips.

3. It is a safe practice to buy fresh rubbers of good quality each year. Discard un-serviceable rings.

TIN CANS

1. Examine the rim of the can. It should be smooth and in good condition. The rim of a can being used for a second or third time should be carefully reflanged.
2. Place a little cold water in an empty can and seal it.
3. Using a pair of tongs, immerse the can in very hot water, keeping the newly-sealed end up and holding the can immersed for several minutes. If no bubbles are seen coming from the top of the can, the seal is perfect and the sealing machine is working properly.
4. The adjustment on any type of sealing machine must be watched closely. Follow directions which come with the machine, and buy a type of machine guaranteed to seal satisfactorily.



A sealing machine in use. Parts of the machine are shown in the foreground of the picture.



A brush with a long handle is convenient for washing sealers. Glass sealers, lids and metal screw bands should be thoroughly washed and rinsed. Keep sealers and lids hot until packed.

GLASS SEALERS

Wash sealers, glass lids and metal screw bands thoroughly in hot, soapy water and rinse in clear, hot drinking water. To keep sealers hot until packed, half fill each sealer with warm water. Place glass lids in position and stand sealers upright on rack in boiler or kettle. Surround with warm water and heat to boiling. Leave in water until ready to fill.

If your oven has automatic heat control, it is often convenient to keep sealers hot in the oven. This method leaves the top of the stove free and the sealers are easily handled. Put glass lids on empty sealers and place on tray in oven. Use bottom heat only. Heat to 200° F. Remove from oven as needed, place on dry cloth and allow to cool *slightly* before using.

RUBBER RINGS AND METAL SCREW BANDS

Dip clean rubber rings, metal screw bands and metal lids with sealing compound into boiling water immediately before use.

TIN CANS

Wash thoroughly in hot soapy water, rinse in boiling water and invert to drain.

CAN COVERS

Do not put covers into water but wipe carefully with clean, dampened cloth. The inside of the edge of the cover is lined with a sealing compound. Discard a cover if the sealing compound is scratched or scraped.

NOTE—When containers packed with food are processed in the boiling water bath, oven or pressure canner, *both containers and the food are sterilized*. Previous sterilization of containers is unnecessary. But all containers should be clean, and glass sealers should be hot to prevent breakage when packed.

PREPARE SYRUP FOR FRUIT

6

QUANTITY AND PROPORTIONS

Consult Chart I, page 6, and estimate the number of quarts of canned fruits which your raw fruit will yield. Work out the amount of syrup to prepare from the following charts.

CHART II

QUANTITY OF SYRUP REQUIRED PER QUART

Fruit	Cold Pack	Hot Pack
Blueberries and saskatoons	$\frac{3}{4}$ cup - 1 cup	
Other small fruits	about $1\frac{1}{2}$ cups	about 1 cup
Large fruits	$1\frac{1}{2}$ cups - 2 cups	about $1\frac{1}{2}$ cups

CHART III

PROPORTIONS FOR SYRUPS

Type of Syrup	Sugar	Water	Amount of Syrup	Method for Syrups
Very thin	1 cup	3 cups	$3\frac{1}{2}$ cups	Measure sugar and water. Heat to boiling, stirring until sugar dissolves. Skim. Prepare syrup a short time before it is required. Re-heat to boiling immediately before use.
Thin	1 cup	2 cups	$2\frac{1}{2}$ cups	
Moderately thin	1 cup	$1\frac{1}{2}$ cups	2 cups	
Medium	1 cup	1 cup	$1\frac{1}{2}$ cups	
Heavy	1 cup	$\frac{3}{4}$ cup	about $1\frac{1}{4}$ cups	

EXAMPLE

Let's suppose you wish to can 1 6-quart basket of pears, using hot pack.

From Chart I, page 6, you estimate your yield to be 5 quarts of canned fruit.

In Chart II, above, you find that each quart of large fruit, hot pack, requires $1\frac{1}{2}$ cups of syrup. Therefore, 5 quarts of fruit will require $7\frac{1}{2}$ cups of syrup.

In Chart III, above, you find that $2\frac{1}{2}$ cups of thin syrup are made from 1 cup of sugar and 2 cups of water. Therefore, $7\frac{1}{2}$ cups of syrup are made from 3 cups of sugar and 6 cups of water.

PREPARE SYRUP FOR FRUIT (Continued)

HONEY AND CORN SYRUP

One quarter of the sugar in a syrup may be replaced by an equal quantity of honey or corn syrup. Usually mild-flavoured light-coloured honey and corn syrup are preferred for canning.

CANNING WITHOUT SUGAR

Shape, colour and flavour are usually better retained when sugar is used but sugar is not essential for preserving fruits. Sufficient processing and airtight sealers are the essentials for keeping qualities. The processing time of fruits canned without sugar may be increased five minutes.

JUICY FRUITS SUCH AS BERRIES, CURRANTS, CHERRIES AND RHUBARB



When these fruits are canned without sugar, use hot fruit juice as liquid to replace syrup. Crush part of the washed fruit in a preserving kettle. Add remaining fruit and heat until juice flows. A small amount of water may be necessary to prevent scorching. Pack solidly in containers, crushing fruit slightly to ensure a covering of juice. Process. (See Time Table for Fuits, page 20 to 22.)

LESS JUICY FRUITS SUCH AS PEACHES AND PEARS

These fruits may be canned according to usual directions, using boiling water to replace hot syrup. (See Time Table for Fuits, page 20 to 21.)

DO NOT USE PRESERVATIVES, CANNING COMPOUNDS OR SACCHARINE

Sufficient processing and airtight sealers will ensure the keeping qualities of your food. Chemicals are not necessary and may be harmful.



CHOOSE QUALITY FOOD FOR CANNING

Do you wish canned food of the highest quality? Then you must choose only first quality fresh food for canning purposes. Many people forget the obvious fact that canning does not improve the quality of food.

Vine-, bush-and tree-ripened fruits have the best flavour. Fruits should be fully ripe but sound. In vegetables, the same degree of maturity that is just right for table use is just right for canning.

Pack "garden freshness" in your sealers or cans. Vine- and tree-ripened fruit should be canned on the day of picking. Vegetables must be canned immediately after gathering. "Two hours from the garden to the can" is the ideal to work for.

SORT

Sort food for blemishes, degree of ripeness and size. In firm foods, such as pears and peaches, small soft spots or bruises can be carefully cut out and the sound portion canned. In watery foods, such as tomatoes and berries, the spoilage organisms spread quickly throughout the whole fruit. Such food should not be used for canning.

Sorting Strawberries and Beans

Sort food for canning for size, blemishes and degree of ripeness. Spoiled or damaged food should not be used for canning.



WASH

All fruits and vegetables should be thoroughly washed. Useful pieces of equipment for washing fruits and vegetables are a wire basket, stiff brush, sieve or tap spray. **Prepare small quantities of food at one time.** Prepared food deteriorates on standing.

Cleanliness is Essential in Canning

Care is necessary in washing easily-bruised foods like strawberries. A tap spray helps you to do the job efficiently.

Wash vegetables like beans several times. Lift vegetable from wash waters.



7. PREPARATION OF FOOD (Continued)

BLANCH

Peaches, apricots and tomatoes are blanched to more easily remove their skins. Place food in wire basket or cheesecloth. Plunge into boiling water for one minute. Plunge into cold water. Blanch a small amount of food at one time.

PEEL

Foods requiring peeling or scraping should have the thinnest possible portion removed.

PREVENT DISCOLOURATION

Dropping such fruits as peaches, pears and apples into a brine of one teaspoon of salt to one quart of cold water helps to prevent discolouration before packing. Change brine as it discolours. Long standing in brine gives a definitely salty taste. Drain fruit thoroughly before packing.

PRE-COOK

Cooking food for a short time before packing in containers is called pre-cooking.

ADVANTAGES

Some of the advantages of packing pre-cooked rather than raw food in containers are listed below:

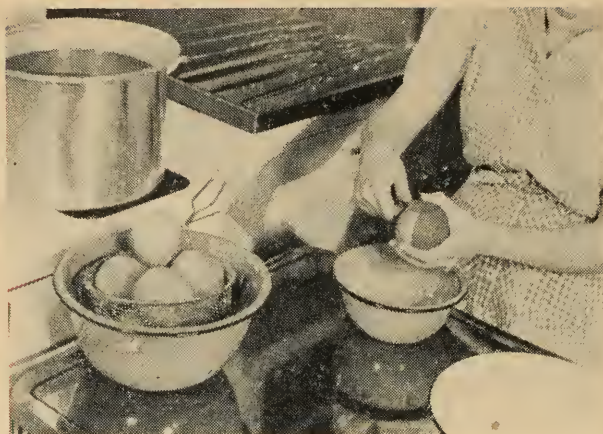
1. Because food shrinks during pre-cooking, more food may be packed into a container and there is less chance of a large "headspace" developing at the top of the container during processing.
2. Pre-cooking reduces the processing time required to ensure the keeping quality of the food. Since it is difficult to destroy spoilage organisms in vegetables (except tomatoes) pre-cooking is always recommended.
3. Pre-cooking, notably of strawberries, may help to prevent "floating fruit."
4. Pre-cooking helps to prevent discolouration in canned apricots, peaches and pears processed in the oven.

AMOUNT OF FOOD

Pre-cook only a small amount of food at one time, to avoid uneven cooking.

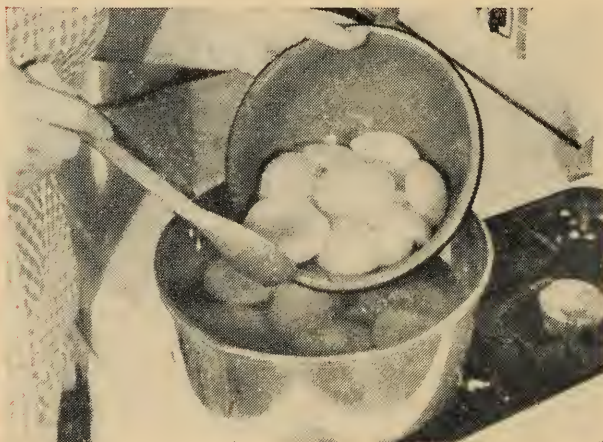
PRE-COOKING TIME

See Hot Pack Methods in Time Tables for Fruits and Vegetables, page 20 to 24.



PEELING PEACHES AFTER BLANCHING

Skins are easily removed from peaches after blanching. Only a small batch of fruit should be prepared at one time. Peeled peaches are dropped into brine.



PRE-COOKING PEACHES

Peaches are dropped into boiling syrup, brought to boil and simmered three minutes before packing in containers.



Pre-cooking is recommended for all vegetables and most fruits.

CONTAINERS

Hot empty containers are removed, one at a time, from the boiler or oven, placed on dry cloth to avoid cracking, and packed quickly.

METHODS OF PACKING

Some foods are always pre-cooked and packed hot. Other foods may be packed hot or cold. Refer to the advantages of pre-cooking, page 14.



Hot pack is recommended for all vegetables and most fruits.

HOT PACK

Pack pre-cooked food in prepared containers. Cover fruits with hot syrup, and vegetables with the hot liquid in which they were cooked. Add boiling water if there is insufficient liquid to cover the food. Leave headspace (see below).

Work quickly.

COLD PACK

Raw cold food is packed in prepared containers. Cover with boiling liquid. Leave headspace (see below).

Work quickly.

Cold pack is recommended for berries, other than strawberries, and for rhubarb. These foods can be successfully processed in a comparatively short time and some, notably raspberries, hold their shape better when packed cold. Strawberries packed raw and cold are likely to float.

Cold pack can be used for most other fruits. However, pre-cooking shrinks fruit, and more fruit can be packed in a container when hot pack is used. To avoid discolouration in the canned fruit, cold pack should not be used for apricots, peaches or pears processed in the oven. Vegetables (except tomatoes) must never be packed cold.

See Time Table for Fruits, page 20 to 22.

HEADSPACE

A headspace is left in all containers to prevent loss of liquid from sealers or bursting of tin cans during processing.

1. GLASS SEALERS

Fill to within $\frac{1}{2}$ inch of top except in case of corn and peas. For these vegetables, allow space of 1 inch.

2. TIN CANS

Fill to within $\frac{1}{4}$ inch of top except in case of peas and corn. For these vegetables, allow a space of $\frac{1}{2}$ inch.

AFTER FILLING

1. Run the blade of a knife down and around the inside of the container to remove air bubbles. This allows a fuller pack and helps to prevent discolouration. Take particular care to work out air bubbles from peaches, pears and apricots to help prevent discolouration in canned fruit.

2. With a clean cloth, remove any particles of food adhering to rim of jar.

9

CLOSE CONTAINERS

SEALERS WITH GLASS LIDS

Dip rubber ring in hot water.

Put wet ring in place, making sure the rubber lies flat.

Put glass lid in place. Continue as outlined below.

SCREW-TOP SEALER

Screw metal band tightly, then unscrew not more than one inch for partial seal.

SPRING-TOP SEALER

Adjust top bail but leave lower bail loose, for partial seal.

VACUUM-TYPE SEALER

Adjust metal clamp for complete seal.

SEALERS WITH METAL LIDS

1. Dip lids edged with sealing compound in boiling water, put in place immediately and completely seal.

TIN CANS

Use sealing machine, the adjustment of which has been previously tested for airtight seal. Follow directions of manufacturer of your machine.

PACK CONTAINERS QUICKLY CLOSE PROCESS IMMEDIATELY

10

PROCESS

Processing is heating food packed in containers to a sufficiently high temperature for a sufficient length of time to destroy any moulds, yeast, bacteria or enzymes which cause spoilage or undesirable changes in the food. Processing is commonly done in a boiling water bath, or oven with an automatic heat control, or a pressure canner.

PREPARATION

HAVE THE PROCESSOR READY FOR THE FOOD WHEN THE FOOD IS READY FOR THE PROCESSOR.

TIME

ALLOW EXACTLY THE REQUIRED LENGTH OF TIME FOR PROCESSING. Count the time for each processor as follows:

BOILING WATER BATH—from the minute the water begins to boil after immersion of packed containers.

OVEN—from the minute the temperature of the pre-heated oven returns to 275° F., after placing packed containers in the oven.

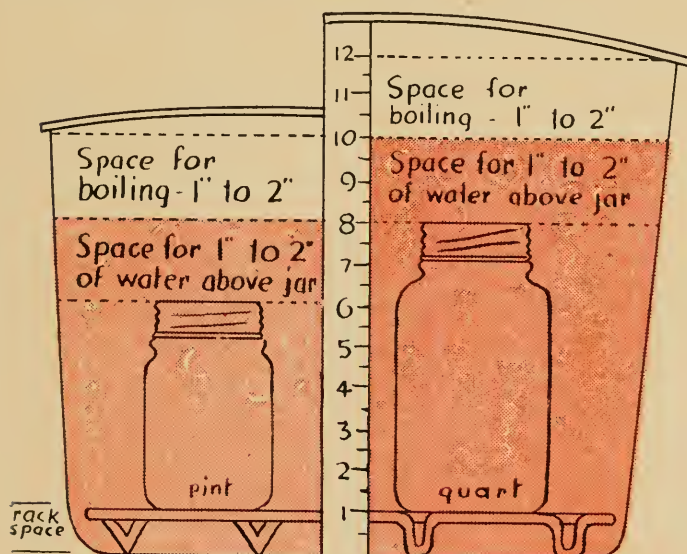
PRESSURE CANNER—from the minute the gauge registers the required pressure.

10.

PROCESS (Continued)

BOILING WATER BATH

Any utensil with a closely fitting lid, several inches higher than the containers being processed, may be used as a boiling water bath. A wire or wooden rack must be used to raise the containers off the bottom of the bath. A boiling water bath may be purchased fitted with a wire rack, or one may be improvised at home using a suitable covered pail, kettle or wash boiler.



HEIGHT OF BOILING WATER BATH IS IMPORTANT

Any boiling water bath must be deep enough to allow sealers to be covered by at least 2 inches of boiling water. This prevents liquid being drawn out of sealers and water of processor entering sealers. If water does not cover containers, uneven cooking will result and food above the water line may discolour.

USE

The boiling water bath is the processor most generally used for fruits and tomatoes. It is sometimes used for vegetables when a pressure canner is not available but it is not recommended. Bacteria causing spoilage in vegetables are difficult to kill and may survive after heating for more than six hours, at boiling temperature.

DIRECTIONS FOR USE

1. Have boiler half filled with water just below boiling temperature. Have boiler ready when containers are packed.
2. Place packed containers on rack at least one inch apart.
3. Add boiling water TO COVER THE CONTAINERS BY TWO INCHES. This is essential for successful processing. Do not pour water directly on jars. Cover the boiler.
4. Time the processing from the minute the water surrounding the containers begins to boil. Keep water boiling. If necessary, add boiling water during the processing period to keep the jars covered.
5. At the end of the processing period, remove jars immediately. Complete sealing of screw-top and spring-top jars at once.

OVEN

The oven method of processing should be attempted only in a well insulated oven with automatic heat control. The control must be accurate.

USE

1. It is frequently more convenient to process in the oven than on top of the stove.
2. Although larger fruits may be processed in the oven, best results with this method have been with small fruits and tomatoes.
3. Pre-cooking is recommended for all larger fruits processed in the oven.
4. The oven method must never be used for vegetables other than tomatoes. These vegetables are difficult to sterilize and the dry heat of the oven penetrates more slowly than moist heat.

5. Due to the danger of explosion, the oven method must never be used for processing in tin cans or in vacuum-type sealers with metal lids.



Sealers ready for processing in oven with automatic heat control. Note that sealers are separated from each other by a few inches to allow free circulation of air and that a tray is placed on bottom oven rack to catch any liquid which may drip from sealers.

**DIRECTIONS FOR USE**

1. Use only the bottom element or burner for canning. Heat oven, in advance, to 275° F.
2. Be certain that spring-top and screw-top sealers are only partially sealed.
3. Place packed sealers about two inches apart on a level oven rack.
4. Place tray or shallow pan beneath oven rack holding jars.
5. When temperature of oven returns to 275° F., start to count processing time. Keep temperature constant during processing.
6. After processing, leave sealers in open oven till bubbling ceases.
7. Completely seal screw-top and spring-top containers.

10.

PROCESS (Continued)

PRESSURE CANNER

Essentially a pressure canner is a utensil with a tightly fitted lid capable of safely withstanding steam pressure up to about twenty pounds. It is fitted with an opening called a petcock from which air contained in the canner is forced out by steam during the initial heating period. When the petcock is closed the entrapped expanding steam creates pressure which is accompanied by a rise of temperature above the boiling point of water. The safety valve is an automatic steam release. The canner must have a gauge which indicates the pressure accurately.

USE

The pressure canner is the only processor recommended for non-acid vegetables.

DIRECTIONS FOR USE

1. Study instructions supplied by manufacturer which accompany each pressure canner.
2. Make certain that openings to petcock, safety valve and pressure gauge are clean. A toothpick may be used for cleaning these openings. Never immerse the lid of the canner in water.
3. Use sufficient boiling water to provide steam for the necessary processing. At least one inch of water is required above the rack.
4. Place hot packed containers in pressure canner at least one inch apart. Tin cans may be stacked if a good circulation of steam on all sides of the cans is allowed.
5. Lock cover on canner with petcock open and heat.
6. Watch for steam to appear from petcock. Allow steam to flow freely for seven minutes to eliminate all air.
7. Close petcock and use maximum heat to raise pressure almost to desired point. Lower heat and start to count processing time when desired point is reached. Keep pressure constant. Fluctuations in pressure cause liquid to be withdrawn from sealers. For processing times, see Time Table for Vegetables, page 23 to 24.
8. After processing the required time, turn off element or burner of electric or gas stove. If a coal or wood stove is used, slide canner to a cooler part of the stove. Allow pressure to return gradually to zero, of its own accord. Too rapid cooling causes liquid to be drawn out of sealers. Sudden cooling may crack the canner.
9. Open petcock slowly. Let canner cool 3 minutes.
10. Carefully remove lid, directing the steam away from the face. At once, cover canner with towel for 2 minutes to prevent possibility of sealers cracking.
11. Remove sealers from canner. Completely seal screw-top and spring-top sealers. With tin cans, open petcock when gauge registers zero. Remove cans immediately.



PROCESSING TIME TABLE FOR FRUITS

Courtesy Consumer Section, Marketing Service, Dominion Department of Agriculture.

- See page 11 for directions for making syrups.
- Allow ½ inch headspace when using glass sealers, and ¼ inch headspace when using tin cans.
- Tin cans may be processed in the boiling water bath or pressure canner but **do not process tin cans in the oven.** When processing tin cans, allow same time for 20-oz. cans as for "small" (pint) sealers and same time for 28-oz. cans as for "medium" (quart) sealers.
- If pressure canner is used for fruits or tomatoes, use the Cold Pack method and allow 5 minutes at 5 pounds pressure for all sealers and tin cans.

	DIRECTIONS	"Small" Sealers (pint)	"Medium" Sealers (quart)
APPLES	Syrup to use—Thin. HOT PACK—Wash, peel, slice or quarter, drop in brine bath. Drain. Bring to boil in syrup and simmer 3 minutes. Pack hot, leaving headspace. Boiling Water Bath Oven—275° F.	Mins. 15 25	Mins. 15 25
APPLE- SAUCE	HOT PACK—Make applesauce, sweeten if desired. Pack hot, leaving headspace. Boiling Water Bath Oven—275° F.	15 25	15 25
APRICOTS	Syrup to use—Moderately thin. COLD PACK—Wash, halve and pit or leave whole. Pack, cups down if halved. Cover with boiling syrup, leaving headspace. Boiling Water Bath HOT PACK—Wash, halve and pit or leave whole. Bring to boil in syrup and simmer 3 minutes. Pack hot, leaving headspace. Boiling Water Bath Oven—275° F.	20 15 25	25 15 25
BERRIES except STRAW- BERRIES	Syrup to use— Blueberries—Very thin. Blackberries, saskatoons—Thin. Raspberries—Moderately thin or Medium. Gooseberries, loganberries—Medium or heavy. COLD PACK—Wash. (Top and tail gooseberries.) Pack. Cover with boiling syrup, leaving headspace. Boiling Water Bath Oven—275° F.	15 25	20 30
CHERRIES	Syrup to use— Sweet Cherries—Thin. Sour Cherries—Medium to heavy. COLD PACK—Wash, stem, pit if desired. Pack. Cover with boiling syrup, leaving headspace. Boiling Water Bath Oven—275° F. HOT PACK—Wash, stem, pit if desired. Bring to boil in syrup and simmer 3 minutes. Pack hot, leaving headspace. Boiling Water Bath Oven—275° F.	20 30 15 20	25 35 15 20

READ ALL DIRECTIONS CAREFULLY — PAGES 7 - 26

PROCESSING TIME TABLE FOR FRUITS

	DIRECTIONS	"Small" Sealers (pint)	"Medium" Sealers (quart)
PEACHES	Syrup to use—Moderately thin. COLD PACK—Blanch 15 to 60 seconds, cold dip. Remove skins and pit. Drop in brine bath. Drain. Leave in halves or slice. Pack, cups down if halved. Cover with boiling syrup, leaving headspace. Boiling Water Bath HOT PACK—Blanch 15 to 60 seconds, cold dip. Remove skins and pit. Drop in brine bath. Drain. Leave in halves or slice. Bring to boil in syrup and simmer 3 minutes. Pack hot, leaving headspace. Boiling Water Bath Oven—275° F.	Mins. 20 15 25	Mins. 25 15 25
PEARS	Syrup to use—Very thin. COLD PACK—Wash, peel, halve or quarter, re- move core. Drop in brine bath. Drain. Pack, cups down. Cover with boiling syrup, leaving headspace. Boiling Water Bath HOT PACK—Wash, peel, halve or quarter, remove core. Drop in brine bath. Drain. Bring to boil in syrup and simmer tender-fleshed varieties 3 minutes; firm-fleshed varieties 5 minutes. Pack hot, leaving headspace. Boiling Water Bath Oven—275° F.	20 15 25	25 15 25
PLUMS	Syrup to use— Sour Plums—Moderately thin. Prune Plums—Thin. COLD PACK—Wash. Leave whole, or halve and pit. Pack Cover with boiling syrup, leaving head- space. Boiling Water Bath Oven—275° F. HOT PACK—Wash. Leave whole or halve and pit. Bring to boil in syrup and simmer 2 minutes. Pack hot, leaving headspace. Boiling Water Bath Oven—275° F.	15 30 10 20	20 35 10 20
RHUBARB	Syrup to use—Medium. COLD PACK—Wash, cut in ½-inch pieces. Pack. Cover with boiling syrup, leaving headspace. Boiling Water Bath Oven—275° F.	10 20	15 25
STRAW- BERRIES	Syrup to use—Medium or heavy. COLD PACK—Wash, hull. Bring slowly to boil in syrup. Cover, remove from heat and let stand 1 hour. Pack, leaving headspace. Boiling Water Bath Oven—275° F. HOT PACK—Wash, hull. Bring syrup to boil in kettle, add strawberries. Cover, remove from heat and let stand 1 hour. Bring to boil. Pack hot, leaving headspace. Boiling Water Bath Oven—275° F.	15 30 10 20	20 35 10 20
SWEET RED PEPPERS	COLD PACK—Wash. Cover peppers with boiling water, bring to boil and boil, covered, for 10 minutes; OR place in very hot oven (450° F.) for 6 to 8 minutes, turning several times, until skins blister. Cold dip. Remove skins, cores and seeds. Pack cold. Add ½ teaspoon salt per "small" (pint) sealer but no liquid. Boiling Water Bath	40	

PROCESSING TIME TABLE FOR FRUITS

	DIRECTIONS	"Small" Sealers (pint)	"Medium" Sealers (quart)
TOMATOES	COLD PACK 1. Blanch 15 to 60 seconds, cold dip, remove stem end, peel. Pack. Add $\frac{1}{2}$ teaspoon salt per "small" sealer (pint). Cover with hot tomato juice, leaving headspace. Boiling Water Bath Oven—275° F.	Mins. 25 35	Mins. 30 45
	2. Blanch, cold dip, remove stem end, peel. Quarter or leave whole. Pack, pressing down until tomatoes are covered with their own juice, leaving headspace. Add $\frac{1}{2}$ teaspoon salt per "small" sealer (pint). Boiling Water Bath	30	35
	HOT PACK —Blanch, cold dip, remove stem end, peel. Quarter or leave whole. Heat to boiling point. Pack hot, leaving headspace. Add $\frac{1}{2}$ teaspoon salt per "small" sealer (pint). Boiling Water Bath Oven—275° F.	15 20	15 20
TOMATO JUICE	HOT PACK 1. Wash tomatoes, remove core, cut into pieces. Bring to boil and boil, covered, 5 minutes. Press through sieve or pureer. Bring juice to boiling point. Pour into containers, leaving headspace. Add $\frac{1}{2}$ teaspoon salt per "small" sealer (pint). Boiling Water Bath Oven—275° F.	15 20	15 20
	2. Wash, remove core. Extract juice, using juice extractor. Heat juice to boiling point. Pour into containers, leaving headspace. Add $\frac{1}{2}$ teaspoon salt per "small" sealer (pint). Boiling Water Bath Oven—275° F.	15 20	15 20
CURRANT JUICE	HOT PACK —Wash, measure and crush currants thoroughly. Add 1 cup water per cup of currants. Bring to boil and boil, covered, 10 minutes. Strain through moistened jelly bag. Add sugar if desired. Reheat to boiling point. Pour into hot containers, leaving headspace. Boiling Water Bath Oven—275° F.	10 15	10 15
GRAPE JUICE	HOT PACK —Wash, stem and crush grapes. Add water, allowing $2\frac{1}{2}$ cups per 6-quart basket of grapes. Bring to boil, and boil, covered, 15 minutes. Strain through moistened jelly bag. Add sugar if desired. Reheat to boiling point. Pour into hot containers, leaving headspace. Boiling Water Bath Oven—275° F.	10 15	10 15
RHUBARB JUICE	HOT PACK —Wash, cut rhubarb in small pieces. Add 1 cup water per quart of rhubarb. Bring to boil and boil, covered, 5 minutes OR steam without adding water. Strain through moistened jelly bag. Add sugar if desired. Reheat to boiling point. Pour into hot containers, leaving headspace. Boiling Water Bath Oven—275° F.	10 15	10 15

READ ALL DIRECTIONS CAREFULLY — PAGES 7 - 26

PROCESSING TIME TABLE FOR VEGETABLES

Courtesy Consumer Section, Marketing Service, Dominion Department of Agriculture.

- When using glass sealers, allow 1 inch headspace for corn and peas and ½ inch headspace for all other vegetables.
- When using tin cans, allow ½ inch headspace for corn and peas and ¼ inch headspace for all other vegetables.
- **Salt:** Add ½ teaspoon to each "small" (pint) sealer or 20-oz. can; 1 teaspoon to each "medium" (quart) sealer or 28-oz. can.

	DIRECTIONS		"Small" Sealers (pint) — 20-oz. Cans	"Medium" Sealers (quart) — 28-oz. Cans
ASPARA- GUS	Wash, break off tough ends of stalks. Remove scales if necessary. Cut in lengths to fit containers. Tie in uniform bundles, stand upright in 2 inches of boiling water. Cover, bring to boil and boil 3 minutes. Pack hot, all tips up, except 3 with tips down, in centre. Add salt. Cover with boiling water, leaving headspace.	PRESSURE CANNER (10 lb. pressure) Boiling Water Bath	30 mins. 2 hrs.	35 mins. 2 hrs.
BEANS Green or Wax	Wash young tender beans. Trim ends, string if necessary. Leave whole or cut in pieces. Cover with boiling water. Bring to boil and boil, covered, 3 minutes. Pack hot. Add salt. Cover with hot cooking liquid from beans, leaving headspace.	PRESSURE CANNER (10 lb. pressure) Boiling Water Bath	30 mins. 2 hrs.	35 mins. 2 hrs.
BEETS	Wash small, young beets. Leave on roots and 2 inches of stem. Cover with boiling water. Bring to boil and boil, covered, until skins slip off easily, about 20 minutes. Remove skins and roots. Pack hot. Add salt. Cover with boiling water, leaving headspace.	PRESSURE CANNER (10 lb. pressure) Boiling Water Bath	30 mins. 2 hrs.	35 mins. 2 hrs.
CARROTS	Wash and scrape young tender carrots. Cover with boiling water. Bring to boil and boil, covered, 5 minutes. Pack hot in upright position, alternating stem and root ends. Add salt. Cover with boiling water, leaving headspace.	PRESSURE CANNER (10 lb. pressure) Boiling Water Bath	30 mins. 2 hrs.	35 mins. 2 hrs.
CORN Whole Kernel	Cover cobs with boiling water. Bring to boil and boil, covered, 4 minutes. Cold dip. Cut whole kernels from cob. Add boiling water, using half as much water as corn. Bring to boil and pack hot, very loosely, leaving headspace. Add salt.	PRESSURE CANNER (10 lb. pressure) Boiling Water Bath	55 mins. 3 hrs.	65 mins. 3 hrs.

READ ALL DIRECTIONS CAREFULLY — PAGES 7 - 26

PROCESSING TIME TABLE FOR VEGETABLES

	DIRECTIONS		"Small" Sealers (pint) — 20-oz. Cans	"Medium" Sealers (quart) — 28-oz. Cans
CORN Cream Style	Wash cobs. Slice thin layer from kernels of cob. Next, slice remainder of kernels from cob and finally scrape cob to remove any cream or juice. Add boiling water, using half as much water as corn. Bring to boil, stirring to prevent scorching. Pack hot, very loosely, leaving headspace. Add salt.	PRESSURE CANNER (10 lb. pressure) Boiling Water Bath	65 mins. 3 hrs.	— —
GREENS Spinach Chard Beet Tops Kale	Wash thoroughly. Cook, covered, in very little water until thoroughly wilted, about 5 to 8 minutes, turning several times during cooking. Pack hot, loosely. Cut greens crosswise with a sharp knife to bottom of container. Add salt. Cover with boiling water, leaving headspace.	PRESSURE CANNER (10 lb. pressure) Boiling Water Bath	50 mins. 3 hrs.	60 mins. 3 hrs.
PEAS	Shell and wash young tender peas. Cover with boiling water. Bring to boil and boil, covered, 1 minute. Pack hot, loosely. Add salt. Cover with hot cooking liquid from peas, leaving headspace.	PRESSURE CANNER (10 lb. pressure) Boiling Water Bath	40 mins. 3 hrs.	45 mins. 3 hrs.
PUMPKIN and SQUASH	Cut or break apart. Remove seeds and stringy fibres. Cut into pieces. Steam, bake or boil in small amount of water until tender. Scrape from skins and mash or sieve. Bring to boiling point, adding a little water, if necessary, to prevent scorching. Pack hot, leaving headspace.	PRESSURE CANNER (10 lb. pressure) Boiling Water Bath	70 mins. 3 hrs.	80 mins. 3 hrs.
MUSH- ROOMS	Wash and peel. Drop into acidulated water (1 tablespoon vinegar per quart water). Drain. Boil 3 minutes in fresh water to which vinegar and salt are added (1 tablespoon vinegar and 1 teaspoon salt per quart water). Pack hot. Cover with boiling water, leaving headspace.	PRESSURE CANNER (10 lb. pressure) Boiling Water Bath	30 mins. 2 hrs.	35 mins. 2 hrs.

- If a pressure canner is not available, the boiling water bath may be used for canning vegetables, but great care must be taken to allow the full processing time.
- **Any vegetable (except tomatoes) processed in the boiling water bath should be boiled for 10 minutes in an uncovered saucepan before using or even tasting.**

READ ALL DIRECTIONS CAREFULLY — PAGES 7 to 26

SEAL

After processing, to prevent cracking, do not place hot jars in draughts or on metal or porcelain surfaces. Place on folded dry cloth or newspaper. Do not touch with damp cloth. Complete the seal on screw-top and spring-top sealers immediately.



Hot sealers, after removal from the processor, are placed on a folded dry cloth to prevent cracking.

COMPLETE SEAL

SCREW-TOP SEALER Tighten metal screw band as soon as possible after removal from processor. Never tighten the band after the sealer is cold. This may break the seal.



SPRING-TOP SEALER The lower bail of a spring-top sealer is snapped down.

VACUUM-TYPE SEALER No further adjustment is necessary. A complete seal forms as the sealer cools.

NEVER OPEN a sealer after processing to fill a space which may develop at the top of the jar during the processing period. This space is caused by shrinkage of the contents or loss of liquid during processing and will not reduce the keeping qualities of the food. Opening a sealer to put in more liquid would expose the food to spoilage organisms in the air.

HANDLING

Sealed jars should have a minimum of gentle handling.



12

COOL

GLASS SEALERS

1. Cool all sealers in an upright position. Inverting sealers may result in an imperfect seal.
2. Cool uncovered and out of draughts.
3. Leave space between sealers while cooling.
4. Do not disturb sealers for 12 hours.

TIN CANS

1. Plunge immediately into cold water.
2. Change water for rapid cooling.
3. Leave in water until cold.

13

TEST FOR LEAKAGE

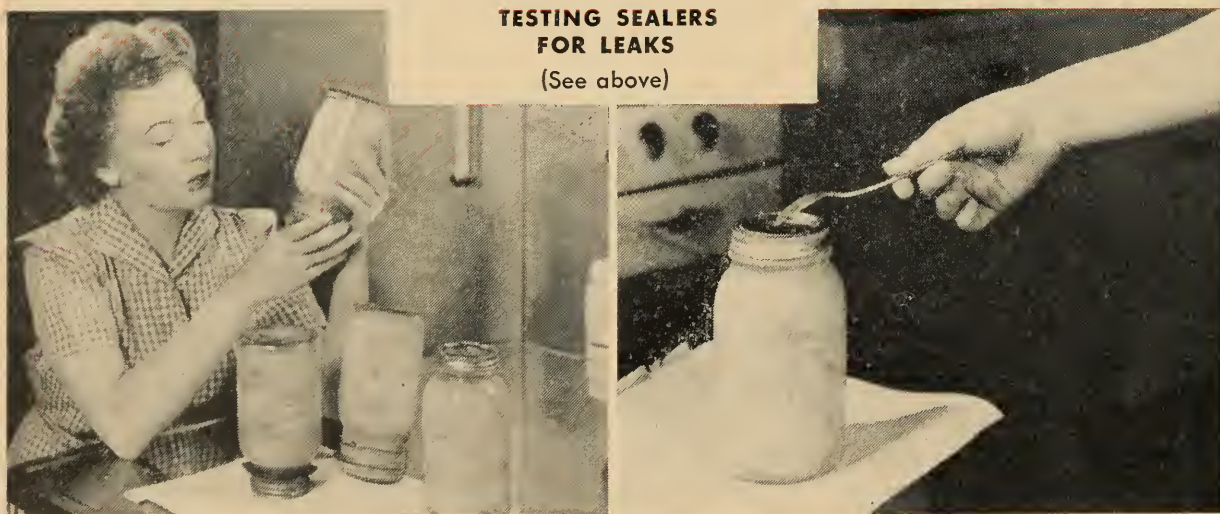
SCREW-TOP AND SPRING-TOP SEALERS

Carefully invert for a few minutes when cold.

VACUUM-TYPE SEALERS

Never invert. When cold, test vacuum-type sealer with metal lid by gently tapping lid with spoon. There should be a clear ringing sound and the lid should be curved slightly inward.

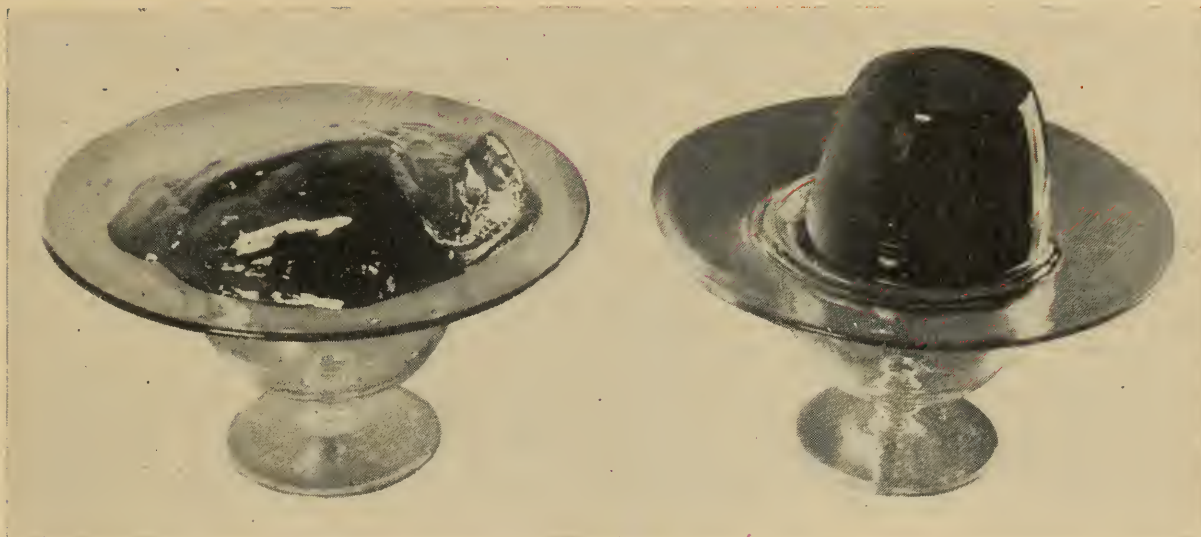
IF A SEALER LEAKS, USE FOOD BEFORE IT SPOILS

**14**

STORE

1. Before storing, wipe jars clean and label with name, date and recipe identification.
2. Store in dry, dark and uniformly cool place.

JELLIES



There are great variations in the quality of home made jellies. Success in jelly-making is not a matter of luck. It is a matter of knowledge. To make good jelly, we must know what is essential for the formation of the jelly and the conditions which best control the results.

FACTORS IN JELLY MAKING

PECTIN

Pectin is the constituent of fruit which gives jellying properties to the juice. It is found under the peel and around the core and is more abundant in slightly under-ripe fruit than in either green or over-ripe fruit. The pectin content of fruit juices varies from time to time with the variety of fruit, the degree of ripeness, the season and the locality in which the fruit is grown. Hence it is necessary to test the juice for pectin each time jelly is made.

Pectin is readily dissolved in liquid by heat, so juice from cooked fruit contains more pectin than the raw fruit juice. But cooking fruit juice at boiling temperature for prolonged periods tends to destroy the pectin. *Hence, in preparing the juice, cook the fruit at simmering temperature. Do not boil.*

ACID

Fruits vary in their acid content as indicated by their tartness.

Fruit acids play an important part in the extraction of pectin and in the setting of the jelly. A definite amount of acid is necessary for good jelly.

WATER

Water is essential because it dissolves the pectin and makes possible its extraction from the fruit pulp. It is present to some extent in all fruits but more so in juicy varieties. Some fruits require additional water for cooking.

SUGAR

Sugar is added to the fruit juice to improve the texture, flavour and yield of the finished product. The amount of sugar required to give a good jelly varies with the pectin content of the fruit juice (see Chart IV, page 28). Other conditions being equal, too much sugar gives a weak jelly and too little sugar a tough one.

CHART IV

CLASSIFICATION OF FRUITS ACCORDING TO JELLING PROPERTIES

Group 1	Group 2	Group 3	Group 4	Group 5
Sufficient Pectin Sufficient Acid	Sufficient Pectin Low in Acid	Low in Pectin Sufficient Acid	Low in Pectin Low in Acid	Not Good for Jelly but Good for Jam
Sour Apples Currants Cranberries Gooseberries Grapes (Concord) Sour Plums	Mild-flavoured apples (crab- apples) Blueberries Oranges Sweet Plums Quinces Raspberries	Sour Cherries	Elderberries Pears Pineapple Strawberries	Apricots Peaches Strawberries

DIRECTIONS FOR MAKING GOOD JELLY

PREPARING THE FRUIT

1. Study Chart IV. Fruits in the first two columns make good jelly without additional pectin.
2. Use a mixture of ripe and slightly under-ripe fruit in the proportion of 1 cup ripe to 2 cups under-ripe to give good flavour and colour as well as maximum pectin.
3. Wash and remove stems and blemishes. Do not peel or core.
4. If fruit is low in acid, add lemon juice to the raw fruit. Mash the fruit or cut into small pieces. Measure. To each quart of raw fruit add:

For ripe apples....	6 tablespoons lemon juice
" crabapples....	4-6 tablespoons lemon juice
" blueberries....	¼ cup lemon juice
" oranges.....	½ cup lemon juice
" plums (sweet)..	½ cup lemon juice
" quince.....	½ cup lemon juice
" raspberries ...	¼ cup lemon juice

Instead of adding lemon juice, these fruits may be used in combination with tart fruits, e.g., blueberry with rhubarb; raspberry with red currant; strawberry with gooseberry.

5. Cook the fruit. Pay careful attention to the amount of water added. If the fruit juice is too thin, the prolonged heating necessary to concentrate it destroys some of the pectin and the flavour (see Chart V).

CHART V

COOKING FRUIT FOR EXTRACTION OF JUICE

Type of Fruit	Preparation	Water per Quart of Fruit	Method of Cooking
Soft Blueberries Grapes Raspberries	Mash.	1 cup	Add water. Heat slowly to simmering point. Do not boil. Cook until very soft and mushy.
Medium Currants Gooseberries Plums	Mash or cut.	2 cups	As above.
Hard Apples Crabapples	Cut into pieces.	4 cups	As above.
Very Hard Quince	Cut into pieces.	8 cups	As above.

EXTRACTING THE JUICE

1. Moisten a jelly bag. The bag may be made of factory cotton, two thicknesses of fine cheesecloth, or a clean sugar bag.
2. Pour the hot, cooked fruit into the bag. Let drip into a large container. For a clear product, do not squeeze the bag. For home use the bag may be squeezed by pressing with two wooden spoons. This gives good flavour and greater yield, although not as clear a jelly.
With fruits rich in pectin, as currants, crabapples, gooseberries and quince, two extractions of juice may be made. Measure the pulp. Add an equal amount of water. Cook slowly for 15 to 20 minutes. Extract the juice as at first.
3. Clarify the juice. Whether the first, second or combined extractions, it is advisable to strain the juice through a moist jelly cloth, without squeezing. Let grape juice stand over night in a cold place before straining. This will reduce the number of crystals which may form in grape jelly.

TESTING THE JUICE FOR PECTIN—ALCOHOL TEST

Use rubbing alcohol, which may be purchased at any drug store.

CAUTION !

Rubbing alcohol is poisonous!
Do not let it come in contact with food!
Dispose of the juice after the test is made!
Wash utensils carefully after using!

TO MAKE THE TEST

Pour one spoonful of extracted fruit juice into a small, flat dish. Measure an equal amount of rubbing alcohol. Pour it gently into the dish. Do not stir. Let stand one to three minutes. Examine the results and interpret them by means of Chart VI. Notice that the amount of sugar added to the juice varies directly with the amount of pectin in the juice.

CHART VI

INTERPRETATION OF ALCOHOL TEST

Appearance	Pectin Content	Jellying Qualities of Juice	Amount of Sugar to Add to Each Cup of Juice
Firm, jelly-like mass with little or no liquid.	High	Excellent	1 cup
Two or three clumps of jelly with noticeable liquid.	Medium	Good	$\frac{3}{4}$ cup
A few small stringy lumps of jelly with much liquid.	Low	Fair to poor	$\frac{1}{2}$ cup

If the alcohol test indicates less than a fair pectin content, boil the fruit juice down to half the original volume and repeat the test. Or to each cup of juice add 2 tablespoons of home made or commercial pectin and repeat the test. This addition of pectin eliminates boiling down the juice.

CONVERTING THE JUICE INTO JELLY



Work with small quantities of juice at a time. Best results are obtained with not more than 4 to 6 cups of juice. Measure accurately. Use a broad, flat-bottomed saucepan which fits the burner or element.

1. Measure the juice and add the proper quantity of sugar (as determined by the pectin test).

2. Cook the juice very rapidly. It should boil up to at least twice its volume. Slow cooking at this stage gives a dull, dark jelly of inferior texture and flavour.

3. Test the jelly to know when to remove it from the stove. This is the most difficult of all tests in jelly-making and one which greatly affects the finished product. Utmost care should be taken at this point. Any of three tests may be used. Sometimes a second test affords a check for the inexperienced person.

SPOON TEST

This is the most reliable method but requires practice and experience in making correct observations. Lift a spoonful of the liquid and allow it to drip slowly from the edge of the spoon. As the liquid nears the jelling stage it will form in two distinct, straight-sided drops at the rounded part of the spoon edge. Watch carefully. Test repeatedly. When two drops tend to pull together, forming slanted edges, the jelly is done. Remove from heat at once.



Almost Done



Done

THERMOMETER TEST

This test, although a very easy one, is not always accurate, but it serves as a guide in determining the jelling point. Use a candy thermometer. Boil the juice and sugar until the temperature reaches 220° F.

PLATE TEST

Place a few drops of the liquid on a cold plate and allow it to stand in a cool place for a few minutes. When the liquid sets enough to wrinkle, the jelly is done. **Note**—This test requires from three to five minutes before the observations can be made. Hence it is necessary to remove the saucepan from the heat during this time to eliminate the danger of over-cooking.

4. When the jelling point is reached, take the jelly from the stove. Let stand 30 seconds. Remove scum and pour into sterilized jelly glasses. Let stand a few minutes and remove any air bubbles which have collected on top.

5. Cover the jelly with a thin layer of melted paraffin. This may be done immediately or after the jelly has set.

6. Examine the glasses next day for air holes in the paraffin. If this occurs, cover with another thin coating of paraffin.

Melt paraffin in small teapot reserved for purpose or in a tin can bent to form a spout. Place container with paraffin in dish of hot water to melt the wax.

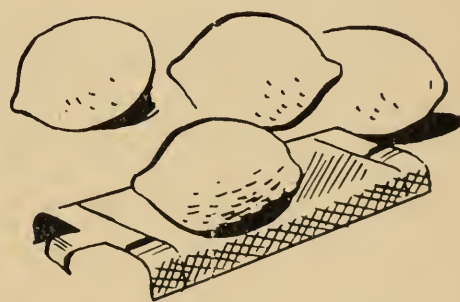


HOME MADE PECTIN

Pectin for use in jelly-making may be prepared from lemons or apples. Lemon pectin is especially satisfactory. The pectin may be made in the jelly-making season and used at once, or it may be processed to keep for future use. Be sure to stir the pectin very thoroughly into the juice.

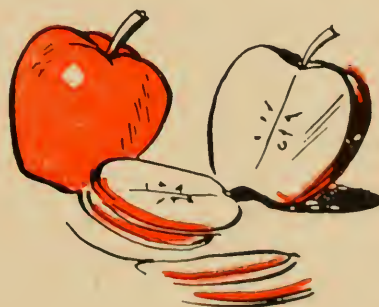
LEMON PECTIN

Grate the outer yellow rind from 4 medium-sized lemons and discard. Remove seeds. Squeeze juice. Grind remainder as fine as possible in a food-chopper. Mix juice and pulp. Add 1 cup of water for each cup of juice and pulp. Simmer for 20 minutes in a covered saucepan. Squeeze as much of the cooked pulp as possible through a moist cotton cloth. If it is to be kept for future use, reheat to boiling. Pour into a sterilized jar and process 45 minutes in a hot water bath.



APPLE PECTIN

Clean slightly under-ripe apples. Do not peel or core. Slice. To 1 pound apples add 1 pint water. Bring to boil quickly. Simmer 20 minutes. Strain through a jelly bag. Press lightly with a wooden spoon. Take pulp from bag and add an equal quantity of water. Simmer again 20 minutes. Strain. Put the first two extractions together in a shallow kettle. Boil rapidly until liquid is concentrated to a quarter of the original amount. Put in sterilized jars and seal tightly.



JAMS, MARMALADES AND CONSERVES

GENERAL DIRECTIONS FOR JAMS

Fruit used for jam should not be over-ripe. It is well to include some under-ripe fruit because of the extra pectin it contains. To prepare the fruit, wash and cut finely or mash. Less juicy fruits may have some water added before cooking. Fruits low in acid are improved by the addition of tart fruit or lemon juice. Heat slowly to extract the juice without burning. Stir frequently. When the fruit is thoroughly cooked, measure the cooked fruit. Add sugar according to the pectin content of the fruit. Refer to Chart IV, page 28, "Classification of Fruits".

- For fruits in Group 1 use $\frac{3}{4}$ cup to 1 cup sugar per cup of cooked fruit.
- For fruits in Groups 2 and 5 use $\frac{1}{2}$ cup to $\frac{2}{3}$ cup sugar per cup of cooked fruit.
- Fruits in Groups 3 and 4 will not make jam without additional pectin.
- It is safer to use too little sugar than too much.
- Stir to dissolve the sugar. Cook quickly to retain colour and flavour.
- Remove from the stove when the mixture will remain heaped up on the lifted spoon or when the jelly test is observed. See page 30. Pour into sterilized glasses and when cold cover with paraffin. See page 31.

MARMALADES

Marmalades are usually made from pulpy fruits which contain both pectin and acid. They are prepared in the same way as jam except that the fruit is not mashed but is cut into small pieces or thin slices. A good marmalade is a jelly-like mass with the pieces of fruit suspended in it.

CONSERVES

A conserve is a jam made of a combination of two or more fruits. If large fruit is used it should be sliced or diced, but small fruit may be left whole. Nuts and raisins or both may be added to any mixture of fruit in the making of conserves. If nuts are used, they should be added to the conserve as it is removed from the fire.

RECIPES

BLUEBERRY JAM*

1 cup blueberries, mashed
 $\frac{1}{2}$ cup water
Few grains of salt

1 tablespoon lemon juice
 $\frac{1}{2}$ cup sugar to 1 cup cooked
fruit

Cook blueberries with water, salt and lemon juice until soft. Measure cooked fruit. Add sugar. Boil to the jelling point.

* Recipes give proportions which have been found satisfactory. In most of the recipes the proportions stated are for 1 cup of fruit. These may be increased as desired, always keeping the same proportions. It is advisable to work with small quantities, not more than 4 or 5 cups of fruit.

GOOSEBERRY JAM*

1 cup gooseberries

1 cup water

$\frac{3}{4}$ cup sugar to 1 cup cooked fruit

Mash or grind the berries. Add the water and cook until soft. Measure the cooked fruit. Add sugar. Boil rapidly to the jelling point.

GRAPE JAM*

Strip skins from pulp. Measure pulp. Add water ($\frac{1}{4}$ cup to 1 cup pulp). Cook until soft. Put through a sieve. The skins may be put through a food chopper. Add skins to pulp. Measure mixture. Add sugar (1 cup to 1 cup mixture). Boil to the jelling point.

GRAPE AND APPLE JAM*

$\frac{3}{4}$ cup apples, cut up
 $\frac{3}{4}$ cup grape pulp

$\frac{3}{4}$ cup water

$\frac{3}{4}$ cup sugar to 1 cup fruit mixture

Cook the apples with the water until soft. Add the grape pulp. Measure the mixture. Add sugar. Boil to the jelling point.

GRAPE JAM—SPICED*

Proceed as for Grape Jam, adding to each cup of mixture approximately $\frac{1}{4}$ teaspoon cinnamon, $\frac{1}{8}$ teaspoon cloves, and $\frac{1}{8}$ teaspoon allspice, ground.

ORANGE, LEMON AND GRAPEFRUIT MARMALADE

2 oranges, large
2 lemons, large

6 pints water

9 cups sugar

1 grapefruit

Peel grapefruit. Remove white pulp from rind. Discard white pulp and cut rind into long fine pieces. Slice fruit pulp.

Oranges and lemons may be prepared as grapefruit. Or, if the skin is not too thick and a large amount of solid particles is desired, cut the oranges and lemons into quarters or eighths lengthwise and slice these across very fine. If

the lemons are not very juicy, add the juice of 1 extra lemon.

To the fruit pulp and rind add 6 pints water. Let stand several hours or overnight. Boil for one-half hour. Add 9 cups sugar. Boil until the jelly test is observed, that is, until the liquid "sheets" when dropped from a spoon.

PEACH JAM*

1 cup peaches, cubed

$1\frac{1}{2}$ tablespoons lemon juice

$\frac{1}{2}$ cup sugar to 1 cup cooked fruit

Cook peaches and lemon juice until soft. Measure the cooked mixture. Add sugar and boil to the jelling point.

PLUM JAM (LOMBARD)*

1 cup plums, pitted and cut up
 $\frac{1}{2}$ cup water

1 tablespoon lemon juice

1 cup sugar to 1 cup cooked fruit

Cook the plums with the water and lemon juice until soft. Measure the cooked fruit. Add the sugar. Boil to the jelling point.

For sweeter varieties of plums use 2 tablespoons lemon juice.

PLUM CONSERVE (DAMSON PLUMS)*

1 quart damson plums
1 orange

Juice of $\frac{1}{8}$ lemon
 $\frac{1}{4}$ cup blanched almonds

$1\frac{1}{2}$ cups sugar

Remove the pits from the plums. Add a small amount of water if necessary, and cook until the skins are soft. Add the chopped orange pulp and sugar. Cook until the mixture is thick and clear. Add the lemon juice at the end of the cooking period. Remove from the fire. Add blanched, slivered almonds. Seal in sterilized jars.

* Recipes give proportions which have been found satisfactory. In most of the recipes the proportions stated are for 1 cup of fruit. These may be increased as desired, always keeping the same proportions. It is advisable to work with small quantities, not more than 4 or 5 cups of fruit.

RASPBERRY JAM*

1 cup mashed berries
 $\frac{7}{8}$ cup sugar to 1 cup cooked fruit

2 tablespoons red currant juice, or
1 tablespoon lemon juice

Add lemon juice to berries and heat slowly. Measure the cooked fruit. Add sugar. Boil to the jelling point.

RED CURRANT JAM*

1 cup currants

$\frac{3}{4}$ cup sugar to 1 cup cooked fruit

1 cup water

Add water to currants and cook slowly. Measure cooked fruit. Add sugar. Boil to the jelling point.

RHUBARB JAM*

1 cup rhubarb

$\frac{1}{4}$ cup water

$\frac{1}{2}$ cup sugar to 1 cup cooked fruit

Cut up rhubarb. Add water. Cook 5 minutes. Measure the cooked fruit. Add sugar. Boil to the jelling point.

RHUBARB AND PINEAPPLE JAM

2 cups rhubarb
1 cup water

1 cup pineapple
 $\frac{1}{2}$ cup sugar to 1 cup cooked fruit

Cook fruit and water together until soft. Measure cooked fruit. Add sugar. Boil to the jelling point.

RHUBARB AND STRAWBERRY JAM*

$\frac{1}{4}$ cup cut rhubarb
 $\frac{1}{4}$ cup water

1 cup crushed strawberries
 $\frac{2}{3}$ cup sugar

Cook rhubarb with water until soft. Add strawberries. Cook very slowly until soft. Add sugar. Boil to the jelling point.

STRAWBERRY JAM (WHOLE BERRIES)*

1 cup whole strawberries

$\frac{2}{3}$ to $\frac{3}{4}$ cup sugar
Juice from $\frac{1}{4}$ cup gooseberries

Add gooseberry juice to strawberries. Simmer until soft. Add sugar. Boil to the jelling point.

THIMBLEBERRY JAM*

1 cup mashed berries
 $\frac{1}{4}$ cup water

$\frac{3}{4}$ cup sugar

1 tablespoon lemon pectin
 $\frac{1}{2}$ tablespoon lemon juice

Add water and lemon juice to berries. Cook slowly until soft. Add lemon pectin and sugar. Mix thoroughly and boil to the jelling point.

* Recipes give proportions which have been found satisfactory. In most of the recipes the proportions stated are for 1 cup of fruit. These may be increased as desired, always keeping the same proportions. It is advisable to work with small quantities, not more than 4 or 5 cups of fruit.

PICKLES

Preserving fruits and vegetables in brine or vinegar is called pickling. In pickles, organisms causing spoilage are controlled by making conditions unfavourable to their growth.

INGREDIENTS FOR PICKLES

FRUITS OR VEGETABLES

Select fresh products of good quality, free from spots or blemishes. Green or slightly under-ripe products give firmer, crisper pickles. Cucumbers should not be allowed to stand more than 24 hours after gathering.

VINEGAR

Use good quality pickling vinegar, free of sediment. White vinegar is preferred for light-coloured foods.

SPICES

These should be used in moderation. Fresh spices should be purchased each year. Spices may be tied in a cheesecloth bag and cooked with vinegar long enough to give a spicy flavour and then removed. Or the spice may be added directly to the vinegar.

ALUM

A small amount of alum may be used in certain pickles for crispness. Never use more than one teaspoon of powdered alum to four quarts of brine. The desired firmness may be obtained by controlling the salt and vinegar content of the brine.

WATER

Soft water is preferred to hard water for pickling purposes. If the water for brine contains much lime, add one tablespoon of vinegar to one quart of water.

SALT

Iodized and free-running salt are not preferred for canning purposes.



RECIPES

BEETS—PICKLED

Cook beets till tender. Remove skins. Pack in sterilized jars. Mix $1\frac{1}{2}$ cups vinegar, $\frac{1}{2}$ cup water, $\frac{3}{4}$ cup sugar and 1 tablespoon salt. Bring to a boil and pour over beets. Seal tightly.

BEET RELISH

8 cups diced cooked beets	1 cup horseradish, grated
$1\frac{1}{3}$ cups diced red peppers	$\frac{1}{2}$ cup sugar
1 cup finely chopped onions	$1\frac{1}{3}$ tablespoon salt
4 cups vinegar	

1. Combine all ingredients and cook until mixture is clear.
2. Pour hot mixture into sterilized jars and seal. Makes 4 pints.

BEETS—SPICED

Cook young beets until tender. Remove skins. Pack in sterilized jars. Cover with boiling spiced vinegar. Process in boiling water bath 15 minutes.

SPICED VINEGAR—

1 cup vinegar	$\frac{1}{4}$ tablespoon cinnamon	$\frac{1}{4}$ tablespoon white mustard
$\frac{1}{2}$ cup sugar	$\frac{1}{4}$ teaspoon allspice	$\frac{1}{4}$ teaspoon cloves
	$\frac{1}{2}$ teaspoon salt	

BREAD AND BUTTER PICKLES

2 cups thinly sliced cucumbers	1 cup sugar
$\frac{1}{4}$ cup thinly sliced onion	$\frac{1}{8}$ teaspoon turmeric
1 cup vinegar	$\frac{1}{2}$ tablespoon mustard

1. Let vegetables stand in weak brine ($\frac{1}{4}$ cup salt to 1 quart water) to cover over night.
2. Drain.
3. Heat remaining ingredients to boil. Add vegetables and bring slowly back to boiling point.
4. Remove from stove and seal in sterilized jars.

CELERY RELISH No. 1

5 cups tomatoes, peeled and chopped	2 cups brown sugar
$\frac{1}{2}$ cup finely chopped onion	2 tablespoons salt
8 cups chopped celery	6 cups vinegar
$\frac{1}{2}$ cup chopped green peppers	

1. Mix ingredients and boil to consistency of sauce (about 1 hour).
2. Seal in sterilized jars. Makes 4 pints.

CELERY RELISH No. 2

2 quarts diced celery	2 cups vinegar
$\frac{1}{2}$ cup finely diced onion	$\frac{1}{2}$ cup sugar
$\frac{1}{2}$ cup finely diced red peppers	1 teaspoon salt
$\frac{1}{2}$ cup finely diced green peppers	1 teaspoon mustard

1. Use large stalks of celery. Chop celery and onions.
2. Cook celery and onions separately in salted water (2 teaspoons salt to 1 quart water) until tender.
3. Drain.
4. Add remaining ingredients and cook until tender.
5. Fill sterilized jars and seal. Makes 4 pints.

CHILI SAUCE

Cook until soft—	
8 quarts tomatoes, peeled and chopped	2 cups diced red peppers
2 cups diced celery	2 cups diced green peppers
2 cups diced onion	

Strain off 3 cups tomato juice. Add to the pulp the following:

3 cups brown sugar	1 teaspoon ground allspice
2 cups vinegar	1 teaspoon ground cinnamon
4 tablespoons salt	1 teaspoon ground cloves
$\frac{1}{2}$ teaspoon ginger	

Boil to the desired consistency. Fill sterilized jars and seal. Makes 8 pints.

CHILI SAUCE WITH FRUIT

2 quarts tomatoes, peeled and quartered
1 cup diced onion
2 cups diced celery
2 cups peaches, peeled and diced
2 cups pears, peeled and diced

2 cups sugar

2 cups chopped sweet red pepper
1 cup chopped green pepper
2 cups vinegar
1 tablespoon salt
 $\frac{1}{2}$ cup whole spice, tied in cheesecloth

1. Combine all ingredients except sugar.
2. Simmer 2 hours.
3. Add sugar and boil 30 minutes.
4. Seal in sterilized jars.

CHOW CHOW

4 cups chopped cucumber (seeds removed)
4 cups chopped cauliflower

4 cups chopped onion
2 cups chopped green pepper

Let soak in strong brine ($\frac{3}{4}$ cup salt to 1 quart water) to cover, over night. Drain well.

Make a sauce from the following:

4 cups sugar
6 tablespoons flour

10 tablespoons mustard
1 tablespoon celery seed
2 tablespoons mustard seed

2 teaspoons turmeric
4 cups vinegar

Add vegetables. Simmer until tender. Seal in sterilized jars. Makes 8 pints.

CORN RELISH No. 1

4 cups corn (kernels cut from cob)
 $1\frac{1}{3}$ cups chopped ripe cucumbers (seeds removed)
 $\frac{2}{3}$ cup chopped onion
 $\frac{1}{3}$ cup chopped red and green peppers
 $1\frac{1}{3}$ cups quartered tomatoes

$1\frac{2}{3}$ cups vinegar
 $2\frac{2}{3}$ tablespoons salt
 $1\frac{1}{3}$ cups sugar
 $\frac{1}{3}$ teaspoon celery seed
 $\frac{1}{3}$ teaspoon turmeric

1. Combine all ingredients, bring to boil and cook until corn is tender.
2. Mix— $1\frac{1}{3}$ tablespoon flour
 $1\frac{1}{3}$ tablespoon mustard
Enough cold water to make a paste
3. Combine flour mixture and corn mixture. Cook 5 minutes. Seal in sterilized jars. Makes 4 pints.

CORN RELISH No. 2

4 cups corn (kernels cut from cob)
2 tablespoons chopped onion
1 cup chopped celery
 $\frac{1}{2}$ cup chopped green peppers
2 cups cabbage, finely cut

2 cups vinegar

$\frac{3}{4}$ cup sugar
1 tablespoon flour
 $\frac{1}{2}$ tablespoon mustard
 $\frac{1}{2}$ tablespoon turmeric
 $\frac{1}{2}$ tablespoon celery seed

1. Cook vegetables in salted water (2 teaspoons salt to 1 quart water) to cover, until tender. Drain.
2. Mix dry ingredients with a little cold vinegar.
3. Heat remaining vinegar, add to paste, and cook till thick.
4. Add cooked vegetables and boil 5 minutes. Fill sterilized jars and seal. Makes 4 pints.

DILL PICKLES No. 1

1. Wash cucumbers and wipe well. Pack in sealers.

To 1 quart jar add:

4 teaspoons salt
1 small, hot, red pepper

1 clove garlic,
dill and savoury

2. Fill jar with mixture of vinegar and water in the proportion of 1 quart vinegar to 2 quarts water.
3. Seal. Ready for use in 6 weeks.

DILL PICKLES No. 2

2 quarts medium-sized cucumbers
6 tablespoons sugar

2 tablespoons salt
2 sprigs fresh dill
or $1\frac{1}{2}$ tablespoon dill seed
diluted vinegar to cover (dilute in proportion of 1 quart vinegar to 2 quarts water)

1. Wash cucumbers and wipe well. Soak in cold water over night.
2. Drain and pack in sealers.
3. Mix remaining ingredients and pour over cucumbers.
4. Seal and store.

DIXIE RELISH

- | | |
|-----------------------------|----------------------------|
| 1 cup chopped red peppers | 2 cups vinegar |
| 1 cup chopped green peppers | $\frac{1}{4}$ cup sugar |
| 1 cup chopped onion | 1 tablespoon celery seed |
| 1 cup chopped cabbage | 2 tablespoons mustard seed |
| 2½ tablespoons salt | |

1. Soak peppers in sufficient brine ($\frac{1}{3}$ cup salt to 1 quart water) to cover, for 24 hours. Drain. Freshen in cold water 1 to 2 hours. Drain.
2. Mix chopped vegetables and let stand in crock over night.
3. Pack in jars. Cover with vinegar and seasonings. Process in boiling water bath 10 minutes.

GRAPE CATSUP

- | | |
|------------------------|----------------------------|
| 6 cups grapes, crushed | 1 teaspoon ground allspice |
| 1½ cups vinegar | 1 teaspoon ground cloves |
| 3½ cups sugar | 1 teaspoon ground cinnamon |
| 1 teaspoon salt | |

1. Cook grapes until soft and rub through a sieve, removing seeds.
2. Add other ingredients and boil to desired consistency.
- Fill sterilized jars and seal. Makes 4 pints.

GREEN TOMATO PICKLE

- | | | |
|-------------------------|--------------------|------------------------------------|
| 4 quarts green tomatoes | 1½ quarts vinegar | 3 tablespoons mustard seed |
| 4 onions | 4 cups brown sugar | 2 tablespoons mixed pickling spice |
| ½ cup salt | 2 red peppers | 2 tablespoons stick cinnamon |

1. Wash tomatoes and cut in $\frac{1}{8}$ inch slices.
2. Peel onions and cut in thin slices.
3. Arrange tomatoes and onions in alternate layers in a crock. Sprinkle salt over each layer.
4. Weight down and let stand over night.
5. Drain.
6. Heat vinegar to boiling. Add sugar, peppers cut in strips and spices tied in cheesecloth.
7. Add vegetables and cook slowly till tomatoes are clear (about 1 hour).
8. Seal in bottles or store in closely-covered crock in cold place.

GHERKINS (SWEET)

- | | |
|--------------------------------------|---|
| 1 pint gherkins | 1 tablespoon mustard seed |
| 1 cup vinegar | $\frac{1}{4}$ tablespoon stick cinnamon |
| ½ tablespoon sugar | $\frac{1}{4}$ tablespoon whole cloves |
| $\frac{1}{8}$ tablespoon celery seed | $\frac{1}{4}$ tablespoon allspice |

Let gherkins stand in medium brine ($\frac{1}{3}$ cup salt to 1 quart water) over night. Drain. Wash in cold water. Drain. Tie the spices in a bag and add to the vinegar and sugar. Bring to boiling point and pour over the gherkins. For this amount of pickles, stir in 1 tablespoon of sugar each morning until the desired sweetness is obtained (about 8 days).

MIXED VEGETABLE MUSTARD PICKLE

Use vegetables in any combination to make approximately 1 quart, such as—

- | | |
|--|--|
| ½ cup onions, sliced or very small | ½ cup tiny cucumbers |
| ½ cup corn, cut from the cob | ½ cup large cucumbers, peeled and sliced |
| ½ cup yellow beans, cut up | |
| ½ cup green beans, cut up | $\frac{1}{4}$ cup chopped green peppers |
| ½ cup cauliflower flowerets, quartered | $\frac{1}{4}$ cup chopped red peppers |
| ½ cup carrots, diced | |

Cover with weak brine ($\frac{1}{4}$ cup salt to 1 quart water) and let stand over night. Drain. Soak one hour in clear water. Drain. Add 1 cup water and 1 cup vinegar and let stand 15 minutes. Cook until vegetables are tender. Drain. Add sour mustard sauce. Let the pickles come to a boil. Fill sterilized jars and seal.

Sour Mustard Sauce

- | | |
|----------------------------------|--------------------------------------|
| 1 tablespoon flour (pastry) | $\frac{1}{8}$ tablespoon turmeric |
| $\frac{3}{4}$ tablespoon mustard | 1 cup vinegar |
| $\frac{1}{4}$ cup brown sugar | $\frac{1}{8}$ tablespoon celery seed |
| Salt to taste. | |

Proceed as for Sweet Mustard Sauce (see Mustard Pickles, page 39).

MUSTARD BEAN PICKLE

1 quart beans, cut in lengths or in halves	$\frac{2}{3}$ tablespoon celery seed
1 pint vinegar	$\frac{2}{3}$ tablespoon turmeric
2 cups sugar	$\frac{1}{3}$ cup mustard
	$\frac{1}{3}$ cup flour

Cook beans until tender. Drain. Make mustard sauce from remaining ingredients. Cover beans and bring to a boil. Pack in sterilized jars and seal.

MUSTARD PICKLES

2 quarts cucumbers	3 green peppers
2 quarts onions	3 red peppers
1 cauliflower	2 heads celery

Chop and cover with hot brine ($\frac{1}{2}$ cup salt to 1 quart water). Let stand over night. Drain. Rinse with cold water. Add sweet mustard sauce. Let pickles come to a boil. Fill sterilized jars and seal.

Sweet Mustard Sauce

$1\frac{1}{2}$ cups flour	$\frac{1}{2}$ ounce turmeric
$\frac{1}{4}$ pound mustard	$\frac{1}{2}$ gallon vinegar
8 cups granulated sugar	2 ounces mustard seed
Salt to taste	

Mix the first four ingredients thoroughly. Make into a thin paste with part of the cold vinegar. Add to the hot vinegar and mustard seed. Cook, stirring constantly until it boils and thickens.

PEPPER RELISH

1 cup chopped onions	$1\frac{1}{3}$ cups chopped red peppers
4 cups chopped cabbage	$2\frac{2}{3}$ cups chopped green peppers

Sprinkle with 4 tablespoons salt. Let stand over night. Drain.

Add—

4 tablespoons mustard seed	2 cups sugar
$\frac{1}{2}$ teaspoon celery seed	2 cups vinegar (white wine)

Cook until it just comes to a boil. Pour into sterilized jars and seal. Makes 4 pints.

RHUBARB RELISH

1 quart rhubarb, cut finely	1 teaspoon cloves
1 quart chopped onions	1 teaspoon allspice
4 cups brown sugar	1 teaspoon cinnamon
2 cups vinegar	1 teaspoon red pepper
1 teaspoon salt	

Boil together until thick. Fill sterilized jars and seal. Makes 4 pints.

RIPE CUCUMBER RELISH

Peel, remove seeds and chop ripe cucumbers to make 4 cups. Add 4 tablespoons chopped onions. Sprinkle with 2 tablespoons salt and cover with water. Let stand 1 hour and drain.

1 cup vinegar	$\frac{1}{8}$ teaspoon ground cloves
$\frac{1}{2}$ teaspoon mustard seed	$\frac{1}{8}$ teaspoon ground cinnamon
$\frac{1}{2}$ teaspoon ground mustard	$\frac{1}{2}$ tablespoon turmeric

Boil the vinegar with the spices tied in a bag. Add vegetables and cook slowly until tender. Pack into sterilized jars and seal. Makes 4 pints.

SPICED OR PICKLED PEACHES, PEARS OR CRABAPPLES

1 quart fruit	$\frac{2}{3}$ cup water	$\frac{2}{3}$ ounce stick cinnamon
1 cup vinegar	$2\frac{2}{3}$ cups sugar	$\frac{1}{3}$ ounce whole cloves

Boil sugar, vinegar and spices 10 minutes. Wash fruit. Rub fur off peaches. Put into syrup and cook until soft. Fill sterilized jars and seal.

SPICED SWEET CHERRIES (Mock Olives)

1 cup vinegar
1 cup cold water
3 tablespoons brown sugar

1 teaspoon salt
 $\frac{1}{2}$ ounce stick cinnamon
1 tablespoon whole cloves

Tie spices in a bag and add to other ingredients. Boil 5 minutes. Cool and remove spices. Wash cherries and pack unpitted in sterilized jars. Pour syrup over cherries and seal.

SPICED SOUR CHERRIES

2 cups sour cherries
 $1\frac{1}{2}$ cups sugar

1 tablespoon ground cinnamon
 $\frac{1}{4}$ tablespoon ground cloves

Vinegar

Sprinkle sugar over pitted cherries and let stand over night. In the morning stir until the sugar is dissolved, heating slightly if necessary. Drain syrup from cherries. Boil syrup and spices to $\frac{3}{4}$ of original volume. Fill sterilized jars with cherries. Cover with hot syrup. Add 2 tablespoons vinegar to each pint. Seal.

TOMATO CATSUP

16 quarts tomatoes, washed and cut up
4 cups chopped red peppers

4 cups chopped onions
4 cups chopped celery

8 bay leaves

Cook until soft. If tomatoes are watery, time and fuel are saved by removing some of the liquid and using it for tomato juice. Remove 4 quarts of juice, boil separately, pour into sterilized jars and seal.

Put the remaining pulp through a sieve. Add the following, tying the spices in a bag:

2 cups granulated sugar
4 tablespoons salt
 $2\frac{2}{3}$ cups vinegar

2 teaspoons mace
2 teaspoons paprika
2 tablespoons peppercorns

2 tablespoons cloves

Cook to the desired consistency. Fill sterilized jars and seal. Makes 4 pints.

WATERMELON RIND PICKLE

$1\frac{1}{2}$ cups watermelon rind (cut 2" x $\frac{1}{2}$ ")
 $\frac{1}{2}$ cup vinegar
 $\frac{1}{2}$ cup water
 $\frac{1}{4}$ lemon, sliced thin

1 cup sugar
 $\frac{1}{4}$ teaspoon whole allspice
 $\frac{1}{4}$ teaspoon stick cinnamon
 $\frac{1}{4}$ teaspoon whole cloves

Soak watermelon rind in medium brine ($\frac{1}{3}$ cup salt to 1 quart water) over night. Drain and wash with fresh water. Drain. Boil in clear water until tender. Mix other ingredients and boil 5 minutes. Add rind and boil until clear. Pack into sterilized jars.



ACKNOWLEDGMENTS

*The cooperation of the following organizations
in the preparation of this bulletin
has been appreciated:*

**CONSUMER SECTION, MARKETING SERVICE,
DOMINION DEPARTMENT OF AGRICULTURE**

**INTERNATIONAL HARVESTER COMPANY
OF CANADA LIMITED**

**CANADIAN WESTINGHOUSE COMPANY
LIMITED**

BETTER ONTARIO PASTURES

CARONAF6
B469

By J. R. WEIR, B.S.A., M.Sc., Ph.D., Professor of Field Husbandry

ONTARIO AGRICULTURAL COLLEGE
GUELPH, ONTARIO



BETTER PASTURES INCREASE PROFITS

ONTARIO DEPARTMENT OF AGRICULTURE

STATISTICS AND PUBLICATIONS BRANCH, TORONTO, ONTARIO

BULLETIN 469

REVISED JULY 1949

Pasture furnishes the *most economical returns* of livestock products. Although we have a rather short grazing season in Ontario, the importance of our pasture land is shown by the fact that we have approximately three million acres under production. Despite this comparatively large

PASTURE AND HAY OCCUPY 55%
OF THE CROP ACREAGE IN ONTARIO



FIELD CROPS - 45%

PASTURE - 25%

HAY - 30%

"Pasture is a major farm crop in Ontario."

acreage, and the importance of this crop in Ontario, a beef and dairy province, *not sufficient care* is given to our pastures.

In most of the major beef and dairy areas the original vegetation was forest. This wooded condition is the type of vegetation best suited to our soil and climate. The land was cleared, but if it were allowed to remain unmolested would return to this condition in a series of orderly changes.

We have all seen these various stages at some time or other on our farms, or throughout the country. A fallow field will grow up with annual weeds, which in turn will be replaced by perennial grasses and weeds. One of the *most common perennial grasses* found in this stage is *Kentucky Blue Grass*. These meadows will be invaded by low growing shrubs and bushes which in turn will be replaced by trees. Thus it will be seen *that it is impossible in these areas* to have such a condition as a *truly permanent pasture*.

All the grasses and legumes grown in our hay and pasture mixtures to-day are introduced species which have had to become adjusted to our local environmental conditions. This adjustment has been greatly hastened by breeding and selecting improved strains of these introductions for adaptability, palatability, yield, nutritional content, disease resistance and other desirable agronomic characters.

For *economical returns* from our pasture lands in Ontario we must have:

- (1) GOOD SEED MIXTURES
- (2) GOOD SOIL PREPARATION
- (3) GOOD SEEDING METHODS
- (4) GOOD AFTER-SEEDING MANAGEMENT

GOOD SEED MIXTURES

While forage plants grow over a wide range of soils and climates they prefer certain specific environmental conditions. It is always good practice to grow those *varieties* or types *adapted to the soil and climate* found on any particular area. Forage plants should be selected also for their *adaptability* to the *purpose* for which they will be used, that is, for hay and pasture in an ordinary farm rotation, or the establishment of a long term pasture.

It is seldom advisable to sow a single species of grass or legume for either hay or pasture, except where pure stands are being grown for seed increase. A mixture of grasses and legumes has many advantages. *Legumes* help to *maintain fertility* and provide a better balanced ration. Mixtures of several grasses and legumes result in a more uniform stand, as soil conditions vary and species differ in periods of peak production. Moreover, grasses do better in association with legumes than when grown alone. In case one species is killed out, others present will tend to spread and maintain a uniform turf.

Since it is impossible in this bulletin to list mixtures suitable for all Ontario conditions, an attempt will be made to give recommended mixtures for the major areas. Changes in the species of forage crops used and the rate of seeding may be made, depending on the particular environment and the availability of the seed. Too much deviation, however, is not advised, as basically these mixtures are composed of legumes and grasses which have proven themselves satisfactory under Ontario conditions. The amount of each variety in the mixture has been determined to give the *proper proportion* of *legumes* and *grasses* necessary for a high quality pasture. Caution should be observed about including varieties in a mixture unless the use of this variety is recommended by a proper source. Grasses and legumes are perennial crops and have to remain in the ground for a number of years. *Non-hardy varieties* will not overwinter and hence their

value is lost, as well as providing bare areas in the stand where undesirable grasses and weeds may become established. Under normal conditions we have several weeks of dry, hot weather in mid-summer, and consequently must have varieties which will be productive through this period, or our returns will drop. Also, we must have *varieties which grow early and rapidly in the spring and late in the autumn* when the temperatures are relatively low.

LONG TERM PASTURES

These are pastures that have been sown to improved strains of grasses and legumes for the purpose of remaining productive for a considerable time. While this time varies greatly with certain factors it is generally understood to be for a period of *at least ten to twelve years*. It will be seen that the major species must be those capable of remaining productive in the ground for a long time. It will be evident also that this land must be removed from the general farm rotation programme. The fact that some of our most productive grasses and legumes are relatively short lived makes it much more difficult to maintain a proper proportion of grasses and legumes in the later years of a long term mixture. Also, we must not overlook the *benefit of the shorter lived legumes on soil improvement*. Experimental work conducted by the Departments of Field Husbandry and Animal Nutrition at the Ontario Agricultural College on long term pastures indicates the *necessity of including in the mixture a generous proportion of high producing legumes*. Not only were the total *yields* for the season greatly *increased*, but the *protein and mineral content* of the fodder was *much higher*. The increased returns of the *legume-grass mixture* over the predominantly grass mixture were *much greater during the dry summer period of July and August*. This is one of the major critical periods of our pasture programme, and anything done to strengthen this weakness will greatly add to the carrying capacity of the pastures and the economy of our beef and dairy production. Since the legumes come into full production in the early years after seeding they serve to keep up the yield until the grasses become more fully established.

The following long term pasture mixtures are recommended for the major areas of Ontario:

Mixture I

Long Term Pasture Mixture for Well-drained Clay-Loam and Heavy Clay Soils, of Average Fertility.

Alfalfa	6 pounds
Ladino Clover ₂	2 "
Timothy	5 "
Brome Grass	5 "
Orchard Grass	4 "
Meadow Fescue	3 "
Total	25 pounds per acre

¹On Heavy Clay Soils reduce Alfalfa and Ladino by one pound each per acre and add Alsike at the rate of two pounds per acre.

²Where particularly dry conditions prevail use White Dutch Clover in place of Ladino Clover.

Mixture II

Long term Pasture Mixture for Light, Sandy and Gravelly Soils.

Alfalfa	3 pounds
White Dutch Clover	1 "
Sweet Clover	4 "
Timothy	5 "
Brome Grass	5 "
Orchard Grass	4 "
Red Fescue	2 "
Canada Blue	3 "
Total	27 pounds per acre

Mixture III

Long Term Pasture Mixture for Low-Lying Poorly Drained Soils Subject to Flooding.

Timothy	5 pounds
Red Top	2 "
Reed Canary Grass	6 "
Meadow Fescue	4 "
Alsike	3 "
Total	20 pounds per acre

The above mixtures differ in the kinds and amounts of the different species of grasses and legumes, based on the response of the species to varying environmental conditions. In the heavier clay soils Alsike is used to partially replace White Dutch Clover. The amount of Orchard Grass is lowered in favour of Brome Grass. On the lighter soils the amount of low growing clovers is reduced, and the legume content maintained by including Sweet Clover. Red Fescue and Canada Blue Grass are species which do better under these soil and moisture conditions than some of the other grasses.

On low-lying poorly drained soils which suffer periodically from flooding Reed Canary Grass has been found very valuable. Alfalfa has been eliminated and the rate of Alsike increased. Red Top has also proven a valuable asset to such a mixture.

Long term mixtures may be seeded either with or without a nurse crop. Experience has shown that thicker pasture stands result when the nurse crop is not seeded too heavily. A light seeding of *early oats* at not more than *one to one-and-a-quarter bushels per acre* has been found to be satisfactory in this connection. This may be pastured, removed as hay, or harvested for grain. When either of the last two methods is used care must be taken to prevent the killing out of the newly seeded grasses and legumes by stooks or coils left in one place too long.

If immediate pasture is desired *Perennial Rye Grass* at from *four to six pounds per acre* may be added to the mixture, and will function as a nurse crop in place of grazing. Where this method is used it is desirable to clip the mixture with sufficient frequency to prevent weeds going to seed.

HAY-PASTURE MIXTURES

A large number of Ontario farmers interested in beef and dairy production have a well planned crop rotation. Any use of the land which

upsets this system is disturbing to the farm programme. One becomes very hesitant about removing the best land from this rotation to place in a long term pasture. If these fields are not removed from the rotation *we still are using our best land in growing our most economical crop.* As mentioned above, experimental work has demonstrated the desirability of including legumes in pasture mixtures. Here is provided an opportunity to combine our hay and pasture requirements, and include the most productive grass and legume varieties without disturbing our crop planning. It also provides the best arrangement for soil improvement, and allows for frequent alternation of different crops.

The following hay-pasture mixtures are recommended for three of the major areas of Ontario. Low-lying, poorly drained soils subject to flooding are being treated as a long term pasture proposition.

Mixture IV

Hay-Pasture Mixture for Well-Drained Alfalfa Land.

Alfalfa	6 pounds
Red Clover	4 “
Brome	5 “
Timothy	2 “
Orchard	3 “
Total	20 pounds per acre

Mixture V

Hay-Pasture Mixture for Moist, Low-Lying Fields not Suitable for Alfalfa.

Red Clover	6 pounds
Alsike	3 “
Ladino	1 “
Timothy	4 “
Orchard ¹	4 “
Meadow Fescue	2 “
Total	20 pounds per acre

¹Where land is really low and wet, include two pounds of Reed Canary Grass and reduce the Orchard by two pounds.

Mixture VI

Hay-Pasture Mixture for Light Sandy and Gravelly Soil.

Alfalfa	4 pounds
Sweet Clover	5 “
Timothy	5 “
Brome Grass	6 “
Orchard Grass	4 “
Total	24 pounds per acre

Mixtures 4, 5 and 6 differ according to the response of the grasses and legumes to these three major soil types. Red Clover, Alfalfa, and Ladino or White Dutch Clover are used on the heavier soils, while Alfalfa and Sweet Clover are used on the lighter soils. The rate of Brome is increased on the lighter soils, while the amount of Orchard Grass and Timothy is decreased. A lower rate of seeding is used on the lighter soils.

Since hay-pasture mixtures are of short term duration and are being included in the regular farm rotation, it is probable that they will be seeded with a nurse crop. *Early oats at not more than one to one-and-a-quarter bushels per acre, or barley at one bushel per acre is recommended.*

GOOD SOIL PREPARATION

The most favourable conditions for the successful establishment of seedlings are a *firm seed bed with adequate moisture and soil fertility*, a fairly cool temperature and a *thinly sown nurse crop*. Quick germination of seeds in a firm, compact, moist soil, seldom fails to bring good results. Best results have been obtained where the soil has been *well cultivated, harrowed*, and then *cultipacked* to firm the seed bed. In certain types of soil where baking is a problem it may be necessary to dispense with the packing operation. Representative soil samples should be taken and sent to the nearest Soil Testing Laboratory, or the Soils Department, Ontario Agricultural College, Guelph, for analysis.

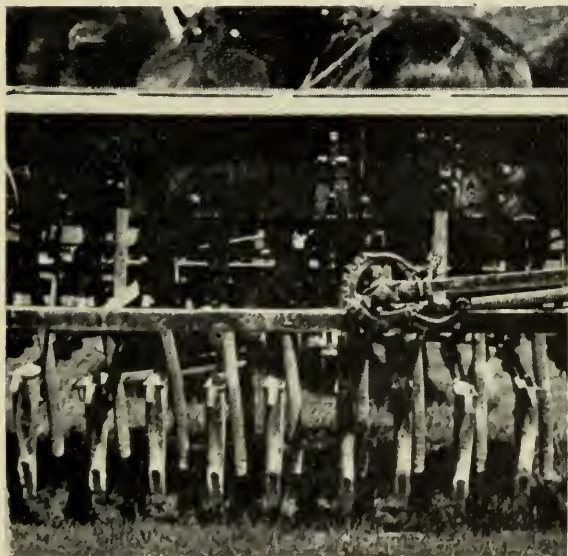
Recommendations from this analysis should be followed in order to bring the soil to the required level of fertility.

Fields should be selected in which the previous cropping practices have ensured freedom against weeds during the establishment of the stand.

GOOD SEEDING METHODS

Grasses may be sown in the fall from September first to fifteenth or in the spring as soon as the land is in shape for seeding. Legumes should be sown only in the spring. The grass varieties are often seeded with winter wheat as the nurse crop and the legume varieties sown broadcast on the stand in early spring.

Hay-pasture mixtures are usually seeded through the grass seeding attachment of a seeder, while the regular crop is planted by means of the grain box. With long term mixtures every care should be taken to give the young plants all the advantages possible. One of the recommended methods of seeding such mixtures is to *sow the nurse crop and fertilizer first at the regular depth*. The field should then be *cultipacked or rolled*, and the *mixture seeded through the grain box on the wheat side* with the



"Seed drill with grain spouts removed for seeding pasture mixture."



"Cyclone Hand Seeder."



"Undergrazing results in low quality pastures."

indicator set at approximately four pecks per acre. If Perennial Rye Grass is included the indicator should be moved up to six pecks per acre. Some grain drills vary individually in their rate of seeding and should be checked the first round for proper calibration. The grain spouts should be removed from the drill.

Another method of seeding that has been widely used, and which has proven satisfactory in most cases is *to seed the grasses and legumes with the exception of the Brome Grass through the grass seed attachment of the drill. The Brome may be broadcast alone before the other seeds are planted, or if a nurse crop is used, the Brome may be mixed with it and both seeded shallow. The depth of seeding Brome Grass should not exceed three-quarters of an inch on average soils and not more than one inch on lighter, sandy soils, when sown with the grain drill.*

Under special conditions, where it is impracticable to use the seed drill, the Cyclone Hand Seeder has proven useful in seeding grass and legume mixtures. Since forage seeds differ greatly in weight there is a tendency for the heavier seeds to be thrown farther than the lighter seeds, resulting in a streaked stand. This can be overcome in part by dividing the seed and sowing in two directions. Seeding legumes in the spring on winter wheat stands or the reseeding of old pastures might be done by this method. Where Brome Grass is included it should not be seeded with the other varieties.

Because grass and legume seeds are very small, and the young plants delicate, the depth of seeding is an important factor in establishing a good stand. *Under average conditions seeding should not be at a greater depth than from one-half to one inch.*

GOOD AFTER-SEEDING MANAGEMENT

The quantity, quality and duration of a well established pasture is dependent to a large extent on the management it receives.



"Pastures should be clipped to control weeds and prevent too coarse a growth."

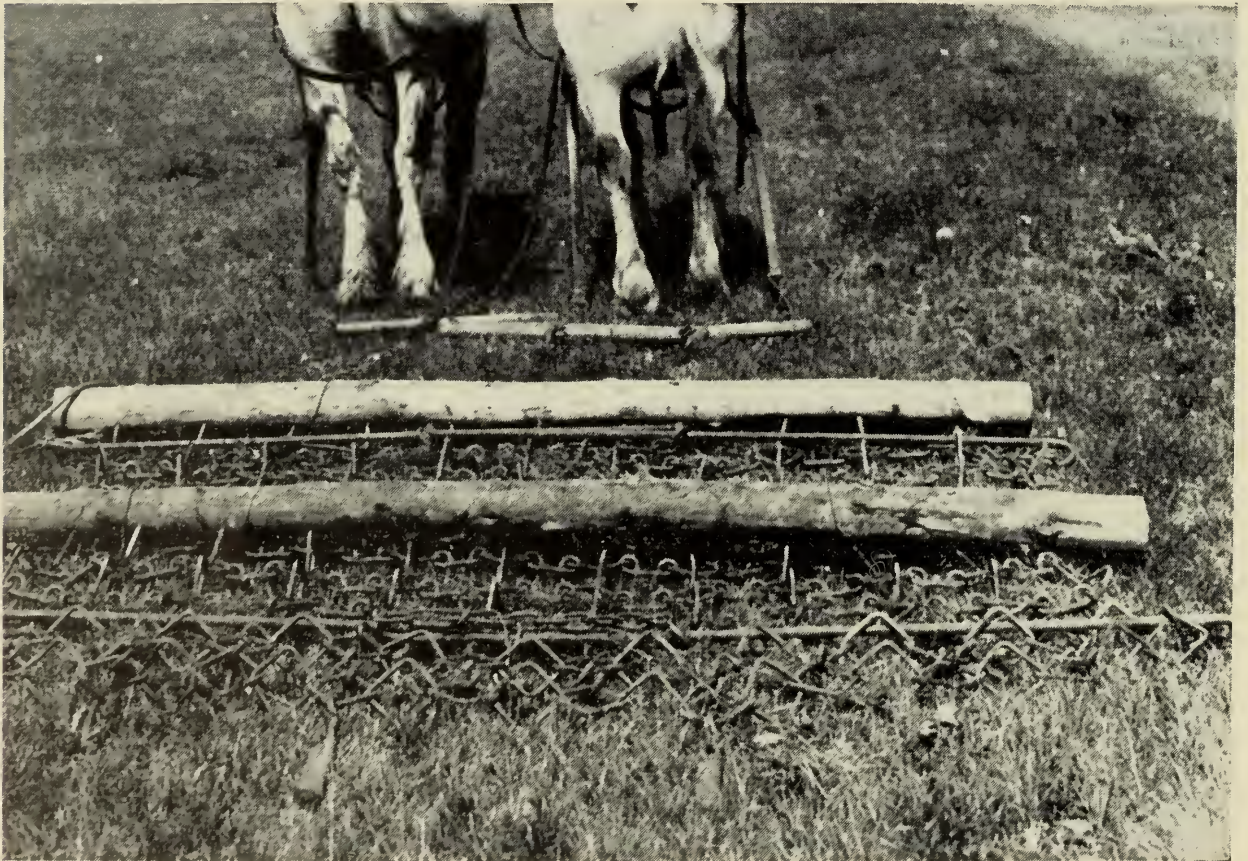
1. It is essential that grazing of seeded pastures should commence early in the spring so that the tall growing grasses and legumes do not smother the bottom grasses and small clovers. However, avoid grazing in the spring before the ground has become sufficiently firm to withstand tramping. *Do not graze before the fresh growth is four inches to six inches tall.* In order to keep the pasture short it is often necessary to carry more stock early in the spring, or part of the field may be separated by means of an electric fence and cut for hay, thereby reducing the acreage for pasture. In mid-summer the entire field may be used as pasture.

2. If there is insufficient livestock to control the growth it is a good policy *to clip the pastures with a mower*, the cutting bar of which has been raised. One cutting in the latter part of June and a second cutting in early September should be sufficient. This helps to control the weeds, especially the first season after seeding, and encourages a more even stand of plants of the various species included in the mixtures. If weeds with a quick recovery are present it may be necessary to clip more frequently. This also tends to thicken the pasture stand.

3. *Top dressing pastures in the fall with barnyard manure and with commercial fertilizers* has proven a very desirable practice. Fertilizers can be applied in the fall before growth has ceased, or very early in the spring, before growth has commenced. If an application of manure has been given in the fall, fertilizer may best be applied in the spring. For pastures a complete fertilizer usually gives the best results. Grasses respond to nitrogen, clovers respond to phosphorus. A 4-12-6 fertilizer is satisfactory at 250 to 350 pounds per acre, or at a rate depending on the soil analysis. *Five to ten tons per acre of light top dressings of manure, preferably phosphated, applied in the fall before growth has stopped*, is the rate suggested in pasture maintenance. If applied in September or early



"Light top dressing of manure, five to ten tons per acre, applied in the fall before growth has stopped, is excellent pasture management."



"The spreading of droppings by means of a drag harrow is desirable in the maintenance of a uniform turf."



"Rotational grazing has proven an excellent aid in maintaining a continuous supply of short, young grass."

October, it will strengthen the growth, increase the winter hardiness, and give a protecting coverage. For further information with regard to the fertility of pasture lands consult the *latest* publication of "*Recommendations for Soil Management and Fertilizer Use*", prepared by the Advisory Fertilizer Board for Ontario and available at the Ontario Agricultural College.

4. *The spreading of droppings whenever necessary by means of a drag harrow* is desirable in the maintenance of a uniform turf. It also increases the palatability of pastures which are heavily grazed.

5. *Rotational grazing* has proven an *excellent aid* in maintaining a continuous supply of short, young grass. The use of an electric fence provides an easy means of dividing pastures into convenient lots for this type of grazing.

6. *Pastures should not be grazed too late in the fall.* They should be allowed to obtain a fair top growth in order to store an adequate food supply to withstand winter conditions and commence growth early in the spring.

AFTERMATH PASTURES

Most Ontario farmers keeping livestock have a well developed hay programme. If the *hay is cut at the proper stage of development* for the *greatest yield of nutrients* there is considerable time left for further growth. This is used very successfully as a source of pasture on many farms. A greater advantage can be made of this aftermath pasture if care is taken to include varieties of grasses and legumes in the mixture which produce a quick growth after cutting. Alfalfa, Ladino, Orchard Grass and Brome have proven very satisfactory in this regard. *Aftermath pastures should not be grazed too late in the season, as such practice impairs next season's growth.*

UNIMPROVED PASTURES

This group includes such areas as woodlots, rough hill land, river bottoms and other types in which the land is unsuitable for tilling. It is needless to say that there are vast areas of such types of pasture throughout the country which play an important part in maintaining livestock.



"Vast areas of such types of abandoned pasture throughout the country play an important part in maintaining livestock."

Improvement practices on these pastures are rather unsatisfactory, as proper soil preparation and usual methods of seeding cannot be employed. The amount to be expended on such practices is obviously governed by the state and topography of the land and the necessity for using these sub-marginal areas. In many cases *raising the fertility level of the soil by top dressing with barnyard manure or commercial fertilizers* has given good results. This is particularly true when soil impoverishment is the main cause of lack of production. The application of *phosphate fertilizer* promotes the *establishment of legumes* which increases the value of the fodder and helps the soil, while the use of *nitrogenous fertilizers* assists the *grass development*. In pastures of this type, where the soil fertility has been increased through top dressing with manure or commercial fertilizer, weeds may still be a problem. These weeds, if susceptible, may be controlled by chemical weed killers if the topography of the land is such that a sprayer may be easily operated. Recommendations for application of these chemicals may be found in the most recent publication on Chemical Weed Control, which may be obtained from the Statistics and Publications Branch, Ontario Department of Agriculture, Toronto. Even if the land can be cultivated or harrowed, more *desirable grass types* may be introduced by *broadcasting seed of certain recommended grass and legume varieties* as Orchard, Brome, Timothy, Kentucky Blue Grass, Alfalfa, and White Dutch Clover. Probably it is not economical to use too expensive a mixture under such adverse conditions.

N.B.—Photographs through the courtesy of the Department of Public Relations, Ontario Agricultural College.

YOUR MONEY'S WORTH IN FOOD.

*out of print
copy 10/13*

120 TESTED RECIPES

ONTARIO
DEPARTMENT OF AGRICULTURE

Statistics and Publications Branch,
Toronto

BULLETIN 470 • APRIL, 1950



*This bulletin
was prepared by the*

NUTRITION SECTION

**WOMEN'S
INSTITUTE
BRANCH**

and

**HOME
ECONOMICS
SERVICE**

**ONTARIO
DEPARTMENT OF AGRICULTURE**

YOUR MONEY'S WORTH IN FOOD

120 TESTED RECIPES

AND
MONEY SAVING
FOOD FACTS



LET'S FACE THE FACTS ABOUT

DAILY NEWS

Members of Crystal
Hamilton, Ont.,
Mrs. Florence
Prec.: Senior
Madely; I.P.S.
O. Church; Jr.
Tomlinson; Rec.
rapps; Fin. Reg.,
Austin; 2nd
Blenis; I.G.,
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FOOD PRICES STILL PROBLEM

(By Staff Correspondent)

EVERYTOWN, April 20, 1950.
—The high cost of food continues
to be the greatest concern of many
Canadian housewives. The retail
food index has advanced from 146
in December, 1946, to 204.0 in
March, 1950. Here are a few
figures. See for yourself.

April, 1946

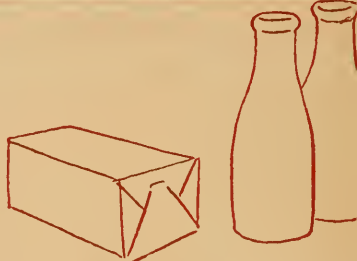
.07	Bread	.14
.11	Milk	.19
.44	Butter	.64
.44	Eggs	.47
.44	Sirloin Steak	.69
.40	Round Steak	.69
.26	Blade Roast	.57
.23	Stewing Beef	.53
.45	Leg of Lamb	.75
.52	Bacon	.55-.69
.19	Lard	.17
.08	Sugar	.09
.45	Coffee	.78-.89
.78	Tea	1.04

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WHAT \$1.00 BOUGHT IN 1937

1 lb. butter		\$.
2 qt. milk		.
2 loaves bread		.
1/2 lb. bacon		.
1 peck potatoes		.
		\$1.

HIGH FOOD PRICES!



WHAT \$1.00 BUYS IN 1950

1 lb. butter	\$.64
2 qt. milk	.38
	\$1.02

WE see by the paper that there's a great hue and cry about the high cost of living and present food prices. The housewife knows only too well her food dollar does not stretch as far as it did in days gone by. Remember when you could barely carry home the groceries purchased with a one dollar bill? Now you tuck them jauntily under one arm.

With such reductions in the purchasing power of the dollar bill, it behooves us all to aim for our "Money's Worth in Food". Food plays such a vital role in health that we cannot afford to lower our health standards even though prices have soared. A solution to our problem is to ensure that every penny we spend buys not only food but food for health. Budget first for health foods!

What are the foods which we require each day for health? How much of each do we need? Nutrition authorities have listed these foods and recommended amounts. This list is referred to as "Canada's Food Rules". Spend your precious food money on the foods included in this list. Spend this money wisely. Your family's health may well depend on it.

CANADA'S FOOD RULES

THESE FOODS ARE GOOD TO EAT.
EAT THEM EVERY DAY FOR HEALTH.
HAVE AT LEAST 3 MEALS EACH DAY.

1 MILK

Children (up to about 12 years): at least 1 pint.
Adolescents: at least 1½ pints.
Adults: at least ½ pint.



2 FRUITS

One serving of citrus fruit or tomatoes or their juices;
and one serving of other fruit.



3 VEGETABLES

At least one serving of potatoes; at least two servings of
other vegetables, preferably leafy, green or yellow, and
frequently raw.



4 CEREALS AND BREAD

One serving of whole grain cereal, and at least four slices
of bread (with butter or fortified margarine).



5 MEAT AND FISH

One serving of meat, fish, poultry, or meat alternates such
as dried beans, eggs and cheese.
Use LIVER frequently.

In addition:

EGGS AND CHEESE at least three times a week each.

VITAMIN D—At least 400 International Units daily for
all growing persons and expectant and nursing mothers.

IODIZED SALT is recommended.

Approved by the Canadian Council on Nutrition, 1949.



WHY WE NEED THESE FOODS

DAILY

CHART 1

CALCIUM RIBOFLAVIN PROTEIN

Milk is our best source of **CALCIUM**, for strong bones and teeth and of **RIBOFLAVIN** (one of the **B VITAMINS**) for energy. It also supplies **PROTEIN**, for body building and repair.

VITAMIN C other VITAMINS MINERALS

Citrus fruits and tomatoes are our most important sources of **VITAMIN C**, needed for strong bones and teeth, healthy gums and blood vessels. Fresh strawberries and cantaloupe are good sources of **VITAMIN C** in Ontario in the summer. Other fruits add variety to meals and provide small quantities of **MINERALS** and **VITAMINS**.

VITAMINS and MINERALS

Vegetables provide **VITAMINS** and **MINERALS** in worthwhile amounts.

Cabbage, turnips and potatoes can provide considerable amounts of **VITAMIN C**.

Raw vegetables provide more **Vitamin C** than cooked vegetables. Poor cooking of vegetables can lead to the total loss of their **Vitamin C**.

Leafy, green and yellow vegetables are sources of **VITAMIN A** needed for health of the eyes and the lining of nose, throat and lungs.

STARCH B VITAMINS

Cereals provide **STARCH** and **B VITAMINS**.

Whole grain cereals, wheat germ, brown flour and brown bread provide more **B VITAMINS** than refined cereals, white flour and white bread.

B vitamins are required by the body to convert starch and sugars into energy.

PROTEIN B VITAMINS IRON

Meat and meat alternates supply **PROTEIN**.

Meats (especially liver and pork) and eggs are important sources of **B VITAMINS**.

Liver, heart, beef and egg yolk are excellent sources of **IRON**, required for the blood.

VITAMIN D

VITAMIN D is required for building strong bones and teeth.

IODINE

The use of iodized salt is recommended to prevent simple goitre.

MEAL PLANNING



FOR NOURISHMENT, ECONOMY AND APPETITE APPEAL

Better balanced meals and greater variety will be the result if meals are planned several days or a week in advance. You will actually save time in shopping and in food preparation too. *Check with Canada's Food Rules, listed on page 4, and see that you have followed them every day.* After the recommended foods have been included, any other foods may be added that your budget permits.

HERE ARE A FEW TIPS ON GOOD MEAL PLANNING

Eye appeal is essential and *contrasts in colour* will furnish this. Bright red tomatoes, fresh green lettuce! They always look tempting!

Contrasts in textures are something else to keep in mind; crunchy salads add interest to soft foods. And speaking of contrasts, watch for combinations of *bland and savoury foods*. Avoid serving more than one

strong flavoured food, such as turnip or onion, at a time.

Flavouring and seasonings play an important part in dressing up meals.

To *avoid monotony*, don't serve the same food twice in different forms in a meal. And while we are on this subject, it is discouraging for the family to know that on Monday there will always be vanilla blanc mange for dessert because Mother is struggling with the family wash. At least take a few seconds to reach for that orange or lemon flavouring and give the folks a change!

And remember to serve hot foods hot and cold foods cold.

TO MARKET!..TO MARKET!

Plan your meals before you go to the store and make out a definite *market list*. This enables you to save time in shopping. In the long run, you will provide better balanced meals with greater variety for less money. Take advantage of any *special sales* and remember that *bulk packages* are usually cheaper than those foods put up in small fancy packages. You save money on canned goods by purchasing "standard" or "choice" quality rather than "fancy" quality. The food value does not increase with the grades. *Make a practice of studying the labels*. The *cheaper cuts of meat* are fully as nutritious as the more expensive cuts and with proper cooking can be made just as palatable. *Foods that are in season* are a good buy because they are at their cheapest in price and highest in food value. Incidentally, fresh fruits and vegetables should be stored in a cool atmosphere to cut down the loss of Vitamin C.

DOLLARS AND SENSE WITH FOOD

We have listed below examples of extravagant and economical foods. By extravagant foods, we mean those that do not provide their share of food essentials in proportion to their cost. Economical foods are those which yield your Money's Worth in Food Value.



EXTRAVAGANT FOODS

"Store" Cookies and Cakes
Prepared Mixes (Pancakes, Pastry, Cake, etc.)
"Store" Pickles and Catsup
Ready-to-Eat Cereals
Special Cake Flours
Canned Soups
Nuts, except Peanuts
Out-of-Season Fruits and Vegetables
Bacon
Cream



ECONOMICAL FOODS

Whole Milk, Skim Milk, and Buttermilk;
Evaporated Milk (depending on local price)
Liver (Beef, Pork), Kidney, Heart
Whole Wheat Flour and Whole Wheat Bread
Wheat Germ
Rolled Oats, Oatmeal, Cracked Wheat, Flaked Wheat
Vitaminized Apple Juice
Canned Grapefruit Juice
Tomato Juice
Canned Tomatoes
Dried Beans, especially Soybeans

LET'S LOOK AT THESE TWO MENUS

FOR A FAMILY OF FIVE, 2 ADULTS AND 3 CHILDREN

MENU I

Tomato juice	\$.11
Rolled oats with 1/2 qt. milk	.12
Poached egg	.19
Whole wheat toast and butter	.17
Homemade jam	.10
Tea for adults	.04
Milk for children, 3/4 qt.	.14

Baked stuffed heart	.44
Potatoes boiled in skins	.04
Baked beet casserole	.15
Raw turnip sticks	.01
Orange almond pudding	.19
Homemade wheat germ muffins and butter	.34
Milk for adults and children, 1 qt.	.19

Savoury macaroni	.41
Crisp cabbage salad	.10
Whole wheat bread and butter	.17
Plum cobbler and fruit sauce	.28
Tea for adults	.04
Milk for children, 1/2 qt.	.10

\$3.33

MENU II

Cornflakes with 3/4 qt. milk	\$.24
Bacon	.52
White bread and butter	.17
Jam	.10
Tea for adults and children	.08

Fried sirloin steak	1.04
Mashed potatoes	.06
Canned corn	.20
White bread and butter	.17
Mincemeat pie	.33
Cookies (store)	.18
Tea for adults and children	.08

Bologna	.32
Fried potatoes	.04
Catsup (store)	.09
White bread and butter	.17
Chocolate pie	.45
Cookies (store)	.18
Tea for adults and children	.08

\$4.50

Menu I provides three square meals in a well planned form that follow all of Canada's Food Rules. See pages 4 and 5. Because Canada's Food Rules have been followed, menu I supplies all the essentials for a balanced diet. The result of careful planning is better eating at lower cost. (The prices here are those of March, 1950.)

Menu II lacks citrus fruit or a good substitute for citrus fruit. The amounts of milk and vegetables are inadequate in the second menu. Too much money is spent on foods that do not justify their cost in terms of food value. Such foods are cornflakes, bacon, expensive cuts of meat, pies used repeatedly, store cookies and pickles.

So we see that good meals do not depend only on the amount of money you spend, but on the wise planning and economical marketing.



THIS YEAR, make your garden bigger and better than ever. The produce that you cannot use or store, preserve for the future by canning or freezing. This is an obvious means of making your food dollar go further. Your rows of fresh carrots and bright tomatoes pay off in health as well as in money.

The Ontario Department of Agriculture, Toronto, distributes free bulletins on vegetable garden requirements, freezing and canning. Write to them for help. In addition, the Dominion Department of Agriculture, Ottawa has booklets on the storage of root vegetables for winter use.

DO YOU KNOW

Do you know that cost alone is not a measure of good family meals?

Do you know that any food which does not do its part to keep your family healthy is an expensive food?

Do you know that low cost foods chosen on the basis of food value will give a much better return in nutrition and health than more expensive foods chosen with no regard for food value?

MAKING USE OF

LEFTOVERS



The best way to prevent leftovers is not to cook more than you know your family will consume. We know families that always have two or three potatoes left in the dinner pot. Therefore, they continually have a leftover problem. A little forethought in marketing is another way of avoiding leftovers. However, if you do find yourself with a surplus, we have listed below a few suggestions on the art of using leftovers.

BREAD

Bread Pancakes
Melba Toast
Bread Crumbs
Bread Puddings

CEREALS

Soups
Puddings

FISH

Chowders
Souffles
Fish Cakes
Sandwiches
Salads

FRUIT SYRUPS

Sauces
Jellies
Puddings

MEAT

Stew
Meat Pie
Hash
Sandwiches
Meat Rolls

Omelets
Salads

SOUR CREAM

Salad Dressings
Sour Cream Pie
Cakes

Meat Dishes
Gingerbread
Cookies

SOUR MILK

Muffins
Griddle Cakes
Cakes
Cottage Cheese

Gingerbread
Salad Dressing

VEGETABLES

Soups
Salads
Creamed on Toast

SOUPS



A HEARTY soup is a “meal in itself”—which you will discover when you try these recipes. You will note that we take advantage of the low cost and high food value of beans and include them in the majority of these soups. Beans help balance the food budget and add nourishment to your daily meals.

SCOTCH SOUP *“For a gathering of the Clan.”*

- ½ c. rolled oats
- 6 c. cold water or vegetable stock
- 3 potatoes, diced
- 1½ medium onions, sliced
- ½ tbsp. sugar
- 1 tsp. salt
- 1 tbsp. fat
- 1 tbsp. flour
- ¼ tsp. celery salt
- 1 c. tomatoes

1. Heat rolled oats and water and boil 30 minutes over direct heat.
 2. Add potatoes, onions, sugar and salt and cook 30 minutes.
 3. Melt fat, add flour and celery salt. Blend.
 4. Stir slowly into soup.
 5. Add tomatoes and reheat.
 6. Taste before serving and add additional salt if desired.
- Serves 6.

LIMA BEAN SOUP *“A delicious cream soup — equally good in June or January.”*

- 1½ c. dried or
- 3 c. cooked lima beans
- 1 small onion, chopped
- 2 tbsp. dripping
- 1 tsp. salt
- ¼ tsp. pepper
- 2½ c. milk
- 2 tbsp. flour
- ¼ c. cold water
- parsley

1. Pick over and wash beans. Soak 6 to 8 hours in cold water and cover.
 2. Heat soaking water to boiling. Add additional boiling water to cover beans and cook until tender 30 to 45 minutes or 12 minutes in pressure cooker.
 3. Force through coarse sieve.
 4. Fry chopped onion in dripping until limp but not brown.
 5. Add lima bean pulp, seasonings and milk and heat over hot water.
 6. Thicken with flour mixed to smooth paste with cold water.
 7. Sprinkle finely cut parsley over the soup just before serving.
- Serves 4-6.

VEGETABLE CHOWDER

- $\frac{1}{4}$ c. barley
- 3 c. boiling water
- $\frac{1}{3}$ c. fat
- 3 tbsp. onion, chopped
- $\frac{1}{3}$ c. celery, chopped
- OR
- $\frac{1}{2}$ tsp. celery salt
- 1 c. carrots, finely diced
- 1 c. potatoes, diced
- $\frac{1}{3}$ c. turnips, finely diced
- 3 tsp. salt
- $\frac{1}{4}$ tsp. pepper
- 3 tbsp. parsley, finely chopped
- 3 c. milk

1. Stir barley into boiling water and cook for 40 minutes.
2. Brown onion lightly in hot fat. Add to barley.
3. Add celery, carrots, potatoes, turnips and seasonings. Cook 30 minutes.
4. Add parsley and cook 10 minutes.
5. Add milk. Heat and serve. Serves 6.

BEAN PUREE SOUP

- 1 c. dried navy beans
- 3 c. cold water
- 4 c. boiling water or leftover vegetable stock
- 1 c. finely chopped celery leaves
- 1 c. finely chopped celery; coarse outside stalks may be used
- 2 c. tomato juice
- 2 tsp. salt
- 2 tbsp. sugar
- $\frac{1}{2}$ tsp. dry mustard

NOTE—

If fresh celery is not available, add $\frac{1}{2}$ tsp. celery salt and 1 tsp. dried parsley with seasonings.

1. Soak beans overnight in cold water.
2. Add boiling water or stock to beans and soaking water.
3. Boil gently $1\frac{1}{2}$ hours. Grease 1" of top inside of pot to prevent boiling over.
4. Add celery and celery leaves. Cook 30 minutes.
5. Press through sieve. (A rotary or puree sieve is wonderful for this purpose).
6. Just before serving, add tomato juice and seasonings. Reheat. Taste. Add additional seasoning if desired. Serve very hot. Serves 5.

BAKED BEAN SOUP

"Ready in double-quick time."

- 1 qt. milk
- 1 slice onion
- $\frac{1}{2}$ tsp. salt
- $\frac{1}{8}$ tsp. pepper
- 2 c. leftover baked beans
- $\frac{1}{8}$ tsp. soda

NOTE—

1-16 oz. tin baked beans may be used in place of leftover beans.

1. Scald milk with the onion, salt and pepper in the top of a double boiler.
2. Combine the beans and soda.
3. Add beans slowly to the milk, stirring constantly.
4. Reheat. Serves 5.

DO YOU KNOW

Do you know that the liquid drained from canned or boiled vegetables is termed "vegetable stock"? This stock should be used in place of water in soups and gravies because it contains important minerals and vitamins.

Do you know that about one-half of the Vitamin C contained in a can of peas is in the vegetable and about one-half is in the juice? Use that juice!

MEATS



MEATS may become a very expensive item in the food budget when care in selection is not practised. Those of you who have your own meat supply tucked away in the frozen food locker probably worry little about the comparative cost of different cuts of meat. On the other hand, families who must purchase all their meat from a butcher's store know that such cuts as prime rib roasts, tenderloin, porterhouse steak, leg of lamb and ham are more expensive to buy than hamburger, chuck or blade roasts, liver, heart and stewing meat.

However, to get "Your Money's Worth in Food", we must consider not only cost but food value, too. And this is good news! The less expensive, less tender cuts are just as packed with nourishment as the more expensive meats. But we have saved the best news until now! **LESS TENDER CUTS MAY BE MADE AS DELICIOUS AS THE MOST EXPENSIVE MEATS BY PROPER COOKING METHODS.** So why should not all of us get our Money's Worth in Meat whether we kill our own or buy it at the store?

First of all, what causes the difference between tender and less tender cuts?

1. Less tender cuts are generally from the more exercised parts of the animal. The muscles are therefore stronger than in less used parts of the body. Meat from young animals is generally more tender than meat from older animals. However, veal, the young of beef, must be prepared carefully to make it tender. (See **Veal** Cookery, page 17).

2. Fat has an effect on tenderness. Cuts with good deposits of fat through the meat and on the outside of the cut are juicier and more tender than leaner cuts of meat. Veal has little fat and is less tender. Pork has a great deal of fat and is always tender. Well finished animals are more tender than animals poorly prepared for slaughter.

HOW TO COOK TENDER CUTS . . .

► *Tender cuts of meat require dry heat methods.
Do not add water and do not cover when cooking.*

1. Roasting or Baking

Use a *slow oven*, 325°. Do not sear roasts at a high temperature as the shrinkage (loss of fat and juices) is greater, the outside of the meat is toughened and heat penetrates more slowly into the meat. *Basting is unnecessary* if the roast is placed fat side up in the pan, in which position the roast bastes itself. Roasts should be 3 lb. or over. Roasts which are boned and rolled require 5-10 more minutes per pound than roasts of the same weight which contain bone.

Time: Beef—Approximately 18-30 minutes per lb. depending on the degree of doneness required.

Internal Temperature (using meat thermometer): Rare — 140°
Medium — 160°
Well done — 170°

2. Broiling

In broiling, meat is directly exposed to the source of heat. Cuts of meat such as chops, steaks or slices of 1"-1½" thickness are broiled. The broiler or oven is preheated and the top of the meat is placed 3"-5" away from very hot coals or flame or burner. Turn meat at half cooking time.

Time: Depends on the thickness and

the degree of doneness required. Beef steaks, 1½" thick, medium done, 20 min.
1" thick, medium done, 15 min.

3. Pan broiling or pan frying

The meat is placed in a preheated frying pan with little or no fat depending on the cut of meat being prepared. After the meat is browned on both sides, reduce the heat to finish cooking. Do not cover the pan. Excess fat should be poured off as cooking proceeds.

Time: Beef steaks 1" thick, 15 minutes.
1½" thick, 20 minutes.

4. Frying

This is similar to pan broiling except that a little more fat may be used.

Do YOU Know . . .

Do you know that cuts of meat containing large proportions of fat and bone are extravagant purchases if both fat and bone are wasted? Fat may be rendered and bones used for soup.

Do you know that "to simmer" means cooking below the boiling point?

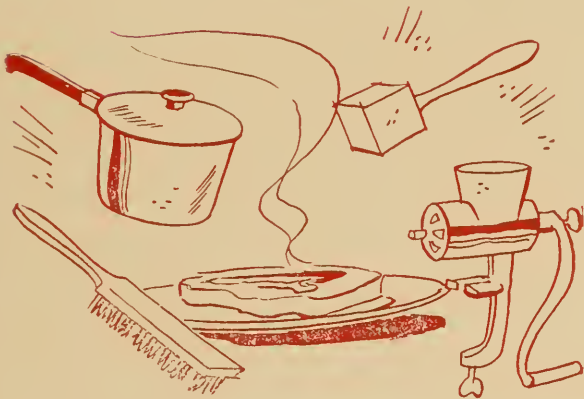
Do you know that "to saute" means to fry in a small amount of fat?

Do you know that a meat thermometer will tell you how the roast is done? Whether it is well done, medium, or rare.



HOW TO COOK LESS TENDER CUTS . . .

➡ *Long, slow cooking at the simmering temperature in moist heat is required. This softens the connective tissue in less tender cuts without causing the meat to fall apart. Never boil meat.*



1. Braising

First, the meat is browned in a small amount of fat to develop flavour and improve appearance. Then a small amount ($\frac{1}{4}$ c.- $\frac{1}{2}$ c.) of water, vegetable stock, meat stock or other liquid is added. More liquid is added, if necessary, as cooking proceeds. Cooking is continued at the simmering temperature on top of the stove or in a moderate oven 350° for 1-2 hours, or until meat is tender. The cooking vessel must be covered tightly. Pot roasts and Swiss steaks are braised.

2. Stewing

Meat is cut into pieces and may be dredged in flour and browned if desired. Then water is added to barely cover the meat. Simmer until the meat is tender, in a tightly covered vessel. Since a good deal of water is added to stews the flavour of the meat is dissolved into the cooking water. More flavour is added in the form of vegetables, seasonings and herbs. Season to taste and cook vegetables the shortest time possible to retain colour and texture. The gravy is

thickened or not as desired. Use 2 table-spoons flour made into a paste with cold water for each cup of liquid. See Chart III and Veal, Lamb and Mutton Cookery for suitable stewing cuts.

3. Other methods of preparation for less tender cuts of meat

Less tender meats may be made more tender by:

(a) *Grinding.* The connective tissue and coarse muscle fibres of tough meats are broken down by grinding. Ground meat made into patties and meat loaves may then be cooked as tender meat by baking, broiling or pan broiling.

(b) *Pounding.* Pounding breaks up the connective tissue and large muscle fibres of tough cuts. Less tender meats are dredged in flour and pounded with a plate or mallet. The flour holds the juices in the meat, otherwise released by pounding. After this treatment, the meat may be tender enough to broil or fry; or braising may be used to continue the tenderizing process.

(c) *Addition of acid.* Moist heat tenderizes the connective tissue and any acid substance added to the meat hastens this process. Tomato in any form, sour milk, sour cream or vinegar are common acids used in meat cookery.

(d) *Pressure Cooking.* In most of the above methods long, slow cooking is required. The pressure cooker, on the other hand, makes tough meat tender in a very short time. Meat cooked under pressure may have a different appearance and flavour from meat cooked slowly in moist heat.

BEEF COOKERY

➡ *Methods of preparation of beef are given in Charts II and III. The general directions given under methods of cooking Tender and Less Tender Cuts therefore apply. (See pages 14 and 15).*

Chart II TENDER, HIGH PRICED CUTS

<u>Name of Cut</u>	<u>Form</u>	<u>Manner of Cooking</u>
Tenderloin Sirloin Porterhouse T-bone Wing or Club	Steaks and Roasts	Broiling, pan broiling Roasting
Prime rib	Boned and rolled or standing roasts	Roasting



Chart III LESS TENDER, LOWER PRICED CUTS

<u>Name of Cut</u>	<u>Form</u>	<u>Manner of Cooking</u>
Rump	Roasts with or without bone, stew	Roasting, braising, stewing, corned beef
Round	Steaks, Swiss steak, pot roast Ground for patties } or meat loaf }	Braising {Baking, broiling, {pan broiling
Flank	Stuffed steak, stews	Braising, stewing
Chuck	Steaks, stews, pot roasts (including blade)	Braising, stewing
Plate	Plate, short ribs	Stewing, braising, corned beef
Brisket	Pot roast, stew	Braising, stewing, corned beef
Shank	Soup bone, stew, heel pot roast, Ground for patties } or meat loaf }	Soup, stewing, braising, {Baking, broiling, {pan broiling
Tail	Soup, stew	Soup, stewing, braising
Neck	Soup, stew Ground for patties } or meat loaf }	Soup, stewing, braising {Baking, broiling, {pan broiling

VEAL COOKERY

▶ *Veal has more connective tissue, less flavour and less fat than beef, and methods of cookery are modified to meet these differences.*

1. *Roasting.* In roasting the larger cuts of veal such as leg, loin, rump, shoulder and rib, the pan may be covered. Long, slow cooking at 325° is recommended until the veal is well done. Since veal has less flavour and fat than beef, additions of fat and seasonings should be carefully made to develop flavour and richness. Roasts of veal are frequently boned and stuffed, to give more flavour.

Time: 30-40 minutes per lb.

Internal temperature (using meat thermometer) 180°.

2. *Cutlets or chops.* For thinner cuts such as cutlets or chops, veal is usually given a protective coating before it is browned in fat. Then some moisture, $\frac{1}{4}$ c.- $\frac{1}{2}$ c. is added, the pan is covered and cooking is completed at a low temperature. Cook slowly on top of stove or in a slow oven, 325°, until veal is

tender, about 45 minutes to 1 hour. This method of cookery prevents the toughening of veal. The protective coating consists of dipping the meat into sifted bread or cracker crumbs, then in egg diluted with a little milk and finally in crumbs. This is known as "breading". The moisture added may be water, tomato in any form, sour cream or fruit juice.

3. *Stews.* For stews veal is cut in small pieces, dredged in seasoned flour and browned in melted fat. Do not burn or overheat. Use 1 tsp. salt for each pound of meat. Cover with water or stock and simmer for 2 hours. Vegetables may be added after 2 hours and cooked until tender. The length of time for cooking depends on the vegetables used and the size of the vegetables. Shank, flank, breast and shoulder are suitable for veal stew.

LAMB and MUTTON COOKERY

▶ *Most cuts of lamb are tender and therefore may be cooked by methods for tender meats: roasting, broiling and pan broiling. Tender and less tender cuts from mutton are similar to those of beef and are cooked as similar beef cuts are cooked. The fat of lamb and mutton is pasty when these meats are not served very hot or cold. For this reason and for general palatability, lamb and mutton should be cooked to the well done stage.*

1. *Roasting.* Roasting of lamb and mutton is done at a slow temperature, 325°. Leg, rack, breast and shoulder of lamb; leg and loin of mutton may be roasted.

Time: 30-40 minutes per lb.

Internal temperature (using meat thermometer) 175°-180°.

2. *Chops.* Broiling and pan broiling are methods used for the thinner tender cuts such as chops.

Time: Broiling: chops 1" thick, 15 minutes. Pan broiling: chops 1" thick, 12 minutes.

3. *Other cuts.* Less tender cuts of mutton are cooked by moist heat methods: braising, stewing, stuffing, or the meat

may be ground and used as patties or in meat loaf combined with other meats. Neck, shoulder, breast and flank of mutton are used in these ways. Similar cuts of lamb may be prepared by these methods.



PORK COOKERY

➤ *Pork has very little connective tissue and is by nature tender. Methods employed for tender meats are therefore used; baking or roasting, broiling and pan broiling depending on the thickness of the cut. Pork should be cooked to the well done stage for two reasons: first, to kill certain organisms which may be present, and second, to develop the rich, full flavour supplied by the fat. Well done pork will have no pink colour.*

1. *Roasting.* Fresh pork and smoked pork are roasted at 325°.

Fresh pork cuts suitable for roasting are: leg, loin, shoulder or butt.

Time: 35-50 minutes per lb.

Internal temperature (using meat thermometer) 185°.

Smoked pork cuts suitable for roasting are: whole or half ham, cottage roll, smoked picnic shoulder and shoulder butt.

Time: Picnic shoulder, 25-45 minutes per lb. Ham, 18-25 minutes per lb.

Internal temperature (using meat thermometer): Smoked shoulder cuts, 170°. Ham, 150°.

2. *Cooking in water.* Smoked or cured pork cuts such as picnic shoulder, cottage rolls, smoked hocks may be covered with cold water, brought to the simmering temperature and cooked for the required length of time.

Time: Cottage rolls, bacon squares, fat back, 45 minutes per lb. Picnic shoulder, 30 minutes per lb. Hams, 15-25 minutes per lb.

Cool hams in the cooking liquid if they are to be served cold. If ham is to be served hot it may be glazed in the oven. After removing the rind, score the ham and spread with a coating of sugar mix-

ture. Brown in a hot oven, 400°, 15-20 minutes. Glazes may be made by mixing one cup brown sugar with any one of the following:

(a) Juice and grated rind of one orange.

(b) 1 cup applesauce.

(c) ½ cup vinegar and 1 tsp. dry mustard.

(d) 1 cup juice from spiced peaches.

(e) 1 can crushed pineapple and ½ cup dry bread crumbs.

3. *Chops.* For thin cuts such as chops ½"-1" in thickness, pan broiling may not be adequate to cook the pork through. After thorough browning it may be necessary to complete the cooking by braising. Cover the pan or add a few tablespoons of liquid to the pan, cover and allow cooking to continue 15-20 minutes longer.

4. *Ham slices.* These may be broiled or pan broiled.

Time: Uncooked ham and picnic slices, 1" thick, 20 minutes.

5. *Other cuts.* Pork is not often used for stews although many delicious stew recipes have come to us from other lands. Ground pork adds flavour and interest when combined with other meats in patties, casseroles and meat loaves.

RECIPES

These recipes offer you methods of preparing chiefly the less expensive cuts of meat. Some of these ideas will make your meat go further by adding sauces, dressings or other extenders. We have tested all the suggestions and liked them well enough to pass them on to you. Hope you like them, too.

STUFFED FLANK STEAK

"Transform the lowliest steak to a tender and tasty dish."

- 1 flank steak (about 1½ lb.)
- 1 minced onion
- ½ c. chopped celery (optional)
- 2 tbsp. fat
- 1½ c. soft bread crumbs
- 1 tsp. salt
- ⅛ tsp. pepper
- 1 tsp. sage

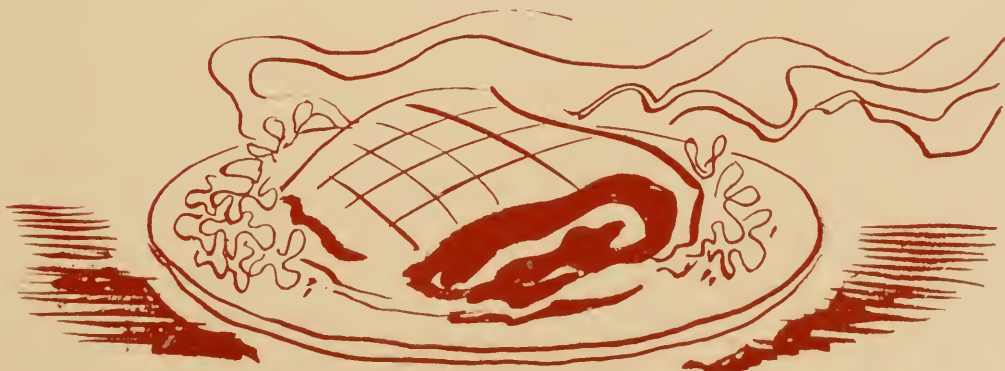
1. Wipe meat with a damp cloth. Score well with knife.
2. For stuffing; brown celery and onion lightly in fat and combine with other ingredients. Spread stuffing over steak.
3. Beginning at one side of the steak, roll like a jelly roll. Tie securely in several places with clean string. (If rolled from side to side, rather than end to end, the cooked meat will be carved across the grain and will be more tender.)
4. Sear in small quantity of fat in heavy skillet or baking pan on top of the

stove, turning meat frequently until browned on all sides.

5. Slip a rack under meat in the pan, cover closely, and cook in slow oven, 300°, 1½-2 hours, or until tender. The stuffed flank may also be braised on top of the stove, closely covered, with ¼ c.-½ c. liquid.
6. When meat is done, remove from the pan and prepare gravy as follows:—

Drain off fat. For each cup of gravy desired, measure 2 tbsp. fat and return to pan, add 2 tbsp. flour and stir until well blended and slightly browned. Then add 1 c. cold water or milk and stir until smooth. Season with salt and pepper. Serve with browned or baked potatoes. Serves 6-7.

NOTE: Other steaks may be used instead of flank steak.



QUICK SWISS STEAK

steak, 1"-1½" thick
flour
fat
salt
pepper
savoury

1. Dredge steak with flour and pound thoroughly.
2. Saute in fat.
3. Cook slowly in uncovered pan—turning the steak two or three times during 30 minutes.
4. Make gravy when meat is done, adding 2 tbsp. flour and 1 c. liquid to each 2 tbsp. fat. Season with salt, pepper and savoury. Serves 6-8.

BEEF AND VEGETABLE STEW

"Try this on your pressure cooker — or the stove."

2 onions, sliced
½ green pepper, diced (optional)
3 tbsp. fat
2 lb. stewing meat (1" cubes)
3 c. hot water or 1 c. hot water and 2 c. tomato juice
1½ c. carrots, quartered
1 c. peas
4 large potatoes, quartered
6 stalks celery 1" lengths, (optional)
2 tsp. salt
pepper
1 tsp. Worcestershire Sauce

1. Brown onions and green pepper in hot fat.
2. Dredge cubed meat in seasoned flour and brown.
3. Cover with hot water and tomato juice and simmer until meat is tender, 1½-2 hours, or cook in pressure cooker 10 minutes.
4. Add raw vegetables and cook until tender, about 30 minutes or 5 minutes in pressure cooker.
5. Add cooked vegetables. Season to taste.
6. If desired, thicken gravy with 2 tbsp. flour mixed with ¼ c. cold water. Serves 8.

QUICK MEAT STEW

"Speedy when you're late with dinner."

2 c. diced cooked meat (beef, pork or veal)
2 tbsp. fat
2 tbsp. flour
1 (10 oz.) can vegetable, mushroom or onion soup

1. Brown meat in fat, add flour and brown.
2. Add soup and cook until thickened.
3. Serve on hot toast, biscuits, mashed potato or cooked rice. Serves 4-5.

MINCED COLLOPS

"That Scottish standby."

1 minced onion
1 tbsp. fat
1 lb. ground beef
1 c. beef broth or vegetable stock
1 tsp. salt
⅛ tsp. pepper
2 tbsp. quick cooking oats

1. Cook onion in fat until yellowed.
2. Add beef and brown slowly, stirring to break up meat.
3. Pour off all but 2 tbsp. dripping. Add broth or vegetable stock and seasonings. Cover and simmer 1 hour.
4. Add oats and cook 5 minutes. Serves 5-6.

MEAT LOAF

"Another recipe for a meal favourite."

- 1½ lb. beef, ground
- ½ lb. pork, ground
- 1 small onion, chopped
- 2 tbsp. fat
- 2 tsp. salt
- ½ tsp. pepper
- ¼ c. bread crumbs
- 1 c. tomato soup or ¾ c. tomato juice
- 2 eggs
- 2 tbsp. chopped parsley

1. Combine all ingredients.
2. Mould into a loaf or press into a greased loaf pan 9" x 5" x 3".
3. Bake in moderate oven 350°, about 1 hour or until done.
4. Pour off excess dripping and save for other uses.
5. To make gravy, use 2 tbsp. dripping and 2 tbsp. flour for every cup of meat stock, vegetable stock or water. Season gravy as desired. Serves 6-8.

BEEF AND LIVER SUPREME

"You'd never guess."

- ½ lb. pork liver (lamb, beef or calf liver, heart or kidney may be used)
- 1 small onion
- ½ lb. ground beef
- 1 tbsp. melted fat
- 1 tsp. salt
- 3 tbsp. flour
- 2 c. tomato juice
- cooked rice or macaroni

1. Pour boiling water over liver. Let stand 5 minutes.
2. Grind with onion.
3. Brown beef in fat.
4. Add liver and onion. Season.
5. Cover and cook slowly, 15 minutes.
6. Stir in flour. Add tomato juice, stirring until thickened.
7. Serve on hot rice or macaroni. Serves 6-8.

BEEF PATTIES

"Variety is the Spice of Life."

- 1 lb. ground beef
- 1 c. grated raw potato (2-3 small potatoes)
- 2 tbsp. grated onion
- 1½ tsp. salt
- ¼ tsp. pepper

1. Combine all ingredients and mix well.
2. Shape into patties (8-10).
3. Place on broiler rack in preheated broiler or oven preheated to 350°, so tops of patties are about 3 inches from heat.
4. Broil on one side until nicely browned, turn and broil on other side. Allow about 10 minutes for each side. Serves 4-5.

PORCUPINES

"Did we say meat?"

- 1 lb. ground beef
- ½ c. bread crumbs
- ¼ c. chopped onion
- 2 tbsp. chopped green pepper (optional)
- 1 tsp. salt
- 1 tsp. paprika
- ½ c. uncooked rice
- 1 (10 oz.) can tomato soup
- 2 c. boiling water

1. Combine beef, crumbs, onion, green pepper, salt, paprika and rice. Mix well.
2. Shape into balls (8-10).
3. Place meat balls in pan, cover with tomato soup and boiling water. Cover and simmer about 45 minutes. Serves 5.

NOTE: An equal quantity of rolled oats may be substituted for rice.

WESTERN RANCH MEAT LOAF *"We stuff anything these days."*

- 1 medium onion, chopped
- $\frac{3}{4}$ c. diced celery (optional)
- $\frac{1}{4}$ c. fat
- $\frac{1}{3}$ c. diced green pepper or chopped relish
- 1 tbsp. salt
- 2 eggs
- 3 c. soft bread crumbs
- $\frac{1}{2}$ c. water
- 2 lb. ground beef
- $\frac{1}{2}$ c. tomato juice
- 2 tbsp. melted fat

1. Brown onion and celery in hot fat.
 2. Combine with chopped relish, salt, eggs, bread crumbs and water to make a dressing.
 3. Add half the dressing to meat, mixing well.
 4. Pat out half meat mixture in loaf pan 10" x 6" x 3".
 5. Cover with remaining dressing, then top with remaining meat mixture.
 6. Bake in a slow oven 300°, 1½ hours.
 7. Baste twice with tomato juice and fat to keep loaf moist.
- Serves 10-12.

BEEF UPSIDE-DOWN PIE

"A delicious, simple treat."

- $\frac{1}{4}$ c. chopped onion
- 2 tbsp. fat
- $\frac{1}{2}$ tsp. salt
- 1 (10 oz.) can tomato soup
- $\frac{1}{2}$ lb. ground beef

1. Cook onion in fat.
2. Add salt, soup and meat and heat to boiling.
3. Put into greased casserole, 1½ qt. size.
4. Top with biscuit mixture. Bake in hot oven, 425°-450°, about 20 minutes. Turn upside-down on serving platter or serve in baking dish. Serves 5.

Tea Biscuit

- $\frac{3}{4}$ c. sifted pastry flour
- $\frac{3}{4}$ c. whole wheat flour
- 3 tsp. baking powder
- $\frac{1}{2}$ tsp. salt
- 1 tsp. paprika (optional)
- 1 tsp. celery salt (optional)
- $\frac{1}{4}$ tsp. white pepper
- 4 tbsp. fat
- $\frac{2}{3}$ c. milk

1. Sift dry ingredients together.
2. Cut in fat.
3. Stir in milk and mix until dough leaves sides of bowl.
4. Drop from spoon on meat mixture in casserole.

CREOLE BEEF WITH RICE OR SPAGHETTI *"A Platter Meal."*

- 1 lb. ground beef
- 3 tbsp. fat
- 1 tbsp. chopped onion
- $\frac{1}{2}$ c. chopped celery (optional)
- 2 tbsp. flour
- 2 c. cooked tomatoes
- $\frac{1}{2}$ tsp. chili powder
- $1\frac{1}{2}$ tsp. salt
- 1 tsp. Worcestershire Sauce
- 1 c. water
- cooked rice or spaghetti

1. Brown meat in 2 tbsp. hot fat. Remove meat from pan.
 2. Brown onion and celery in 1 tbsp. fat. Blend in flour, add tomatoes slowly and stir and cook until thickened.
 3. Add seasonings, meat and water. Cook slowly 10 minutes.
 4. Serve on bed of hot cooked rice or spaghetti. Surround serving platter with cooked vegetables.
- Serves 6.

BEEF STEAK AND KIDNEY PIE *"The Old Favourite."*

- | | | |
|-----------------------------|---|------------|
| 1-1½ lb. beef | } | 2 lb. meat |
| ½-1 lb. kidney | | |
| 1 onion, chopped | | |
| 2 tbsp. fat | | |
| ½ c. flour | | |
| 3 c. hot water | | |
| 4 whole cloves | | |
| ½ tsp. mixed pickling spice | | |
| 2 tsp. salt | | |
| ⅛ tsp. pepper | | |
| biscuit dough or pastry | | |
| (use ½ whole wheat flour) | | |

1. Cut beef and kidney in 1" cubes. Soak kidney for 1 hour in cold salted water.
2. Brown onion in hot fat. Dredge meat with seasoned flour and brown.
3. Add water and spices tied in cheese cloth bag. Season. Cover and simmer slowly 1½-2 hours, removing spices at end of the first hour. In a pressure cooker, cook 15 minutes after pressure is reached. Remove spices at end of first 10 minutes.
4. Place in a greased casserole, 1½ qt. size and cover with biscuit dough or pastry. Cut slits to allow steam to escape.
5. Bake in hot oven 400°, 25 to 30 minutes, until crust is cooked. Serves 6-8.

EXTENDED MEAT LOAF *"With salad, a meal in itself."*

- | | | |
|----------------------------------|---|--------------------------|
| 1 lb. ground veal | } | or 2¼ lb.
ground veal |
| ½ lb. ground pork | | |
| ¾ lb. ground beef | | |
| ½ tsp. powdered sage | | |
| 1½ tsp. salt | | |
| ½ tsp. pepper | | |
| ¼ c. chopped onion | | |
| ½ c. soft bread crumbs | | |
| or uncooked oatmeal | | |
| 2 eggs, slightly beaten | | |
| ½ c. liquid, milk or | | |
| tomato juice | | |
| 1 c. peas | | |
| 1 c. thinly sliced carrots | | |
| 2½ c. mashed potatoes, quite dry | | |
| ¾ c. catsup | | |
| flour | | |

1. Combine all ingredients except potatoes, catsup and flour and mix well. (Reserve 1 tbsp. egg for brushing potato frosting).
2. Pack in loaf pan 9" x 5" x 3". Bake in moderate oven 350°, 1½ hours.
3. Make sauce by thickening liquid from loaf (or use meat drippings or bacon fat). Use 2 tbsp. flour blended with cold water for every cup of sauce desired. Stir in catsup.
4. Unmould meat loaf on baking sheet, frost with mashed potatoes, brush with beaten egg and brown in hot oven 450°, 15-20 minutes. Serves 8-10.

PORK LOAVES *"Try a meat loaf apiece — they're good!"*

- | |
|-------------------------|
| 1½ lb. ground pork |
| ½ c. milk |
| 1½ c. soft bread crumbs |
| 1 egg |
| 1 tsp. grated onion |
| 2 tbsp. catsup |
| 2 tbsp. horseradish |
| 2 tsp. prepared mustard |
| 1½ tsp. salt |
| ¼ tsp. pepper |

1. Combine all ingredients, mixing well.
2. Shape into eight little loaves and arrange side by side in a pan 9" x 9".
3. Bake in a moderate oven 350°, 1½ hours. Serves 6-8.

HASHED MEAT IN CABBAGE LEAVES

- 6-12 cabbage leaves
- 1 lb. minced lamb or other meat (raw or cooked)
- 2 chopped onions
- 1 c. uncooked rice or oatmeal
- 1½ tsp. salt
- ⅛ tsp. pepper
- 1 c. canned tomatoes or juice
- ½ c. water
- meat stock

1. Cook cabbage until tender. Drain.
 2. Combine meat, onions, rice or oatmeal, salt and pepper and mix well.
 3. On each cabbage leaf place some of meat mixture and roll leaf over filling. Turn ends under so as to secure each roll.
 4. Place filled leaves in greased pan, add tomatoes, water and sufficient stock to half cover rolls. Cook in slow oven 300°, about 1¼ hours. If rice is used, it must be tender.
- Serves 6.

PORK AND PARSNIP LUNCHEON DISH

"For the delicate flavour of a Chinese meal."

- 1 lb. fresh pork, 1" cubes
- 1 onion, minced
- 3 c. vegetable stock or water (hot)
- ⅛ tsp. pepper
- 1 tsp. salt
- 3 c. diced cooked parsnips
- 1½ tbs. flour
- 3 tbs. minced parsley

1. Brown pork cubes in their own fat in hot skillet.
 2. When well browned, add minced onion and cook 3 minutes.
 3. Add water and cook gently until meat is almost tender.
 4. Add salt, pepper and parsnips. Continue cooking 10-15 minutes.
 5. Thicken remaining liquid. Serve on a hot platter and sprinkle with parsley.
- Serves 6.

HAM LOAF

"Leftover ham won't worry you, after this."

- 2 c. ground cooked ham
- 1 c. bread crumbs
- 1 egg
- 3 tbs. chili sauce
- 1 c. ground carrots
- 1 c. milk

1. Combine ingredients.
 2. Bake in greased loaf pan, 9" x 5" x 3", in slow oven 300°, about 1 hour.
- Serves 6.

PORK SAUSAGE AND CORN CASSEROLE

"A blend of two well-liked flavours."

- 1 lb. pork sausage meat shaped into 10-12 patties
- 2 tbs. fat
- 2 tbs. flour
- 1 c. milk
- 1 (20 oz.) can cream style corn (2¼ c.)
- 1 c. fine cracker crumbs

1. Fry pork sausage patties until lightly browned.
 2. Make a white sauce with fat, flour and milk.
 3. In a greased baking dish, arrange layers of crumbs, corn, sausage patties and white sauce.
 4. Top with buttered crumbs and a few pork sausage patties. Bake 30 minutes in a moderate oven 350°.
- Serves 5-6.

BAKED SAUSAGE PATTIES

- 1 lb. pork sausage meat
- 1 slice bread
- 1 egg
- 1 medium apple, grated
- $\frac{3}{4}$ tsp. salt

"Puffy and light, a new delight."

1. Combine the sausage and bread which has been broken into small pieces.
2. Add the remaining ingredients.
3. Make into 6-8 patties $\frac{3}{4}$ " thick.
4. Place on rack set in pan and bake in moderate oven 350°, 1 hour.
Serves 5-6.

STUFFED SAUSAGE LOAF

- 1 lb. sausage meat
- 2 c. diced raw apples
- 2 c. soft bread crumbs
- 2 small onions, diced

"Why didn't I try this before?"

1. Mix apple, crumbs and onion thoroughly.
2. Pat out layers of the sausage meat and dressing alternately in a loaf pan 9" x 5" x 3".
3. Bake in a moderate oven 350°, 45 minutes. Serves 6.

BAKED LIVER ROLLS

"We love these at our house."

- $1\frac{1}{2}$ c. cooked liver
- 1 small onion
- 2 tbsp. lemon juice
- 1 tbsp. chopped parsley
- $\frac{1}{2}$ tsp. salt
- $\frac{1}{4}$ tsp. pepper
- milk to moisten

Biscuit dough

- 1 c. sifted pastry flour
- 1 c. sifted whole wheat flour
- 4 tsp. baking powder
- $\frac{1}{2}$ tsp. salt
- 5 tbsp. fat
- $\frac{3}{4}$ c. milk

1. Force liver and onion through food chopper.
2. Add lemon juice, parsley, salt, pepper and enough milk to make mixture moist enough to spread.
3. Mix and sift dry ingredients for biscuit dough.
4. Cut in fat.
5. Add milk, stirring till mixture leaves sides of bowl. Knead 1 minute.
6. Roll biscuit dough into a rectangle, spread with liver mixture and roll as jelly roll.
7. Cut into $1\frac{1}{2}$ " slices or 8 servings, place cut side up in greased pan and bake in hot oven 400°, 15-20 minutes.
8. Serve with barbecue sauce. See page 29.

PORK LIVER LOAF

- 1 lb. pork liver

White sauce

- 1 c. scalded milk
- 2 tbsp. fat
- 3 tbsp. flour
- $\frac{1}{2}$ tsp. salt
- pepper
- 2 tbsp. cooked rice, macaroni or mashed potato
- $\frac{1}{8}$ tsp. paprika
- $\frac{1}{2}$ tsp. chopped onion
- $\frac{1}{8}$ tsp. pepper
- $\frac{1}{4}$ tsp. salt
- $\frac{1}{2}$ tsp. lemon juice

1. Cook liver in salted water until tender, then grind.
2. Make white sauce by melting fat in top of double boiler. Add flour and seasonings and blend thoroughly. Add milk gradually, stirring as milk is added. Stir until thick and smooth.
3. Combine liver, white sauce, rice or mashed potato or macaroni and seasonings.
4. Bake in greased loaf pan 9" x 5" x 3" in moderate oven 350°, about 1 hour. Serve with sauce.
Serves 5-6.

LIVER CASSEROLE

- 1 lb. sliced liver
- 2 tbsp. fat
- 3 c. brown gravy (or use 3 c. water plus 2 bouillon cubes)
- 2 tbsp. flour
- $\frac{1}{4}$ c. water
- 1 c. raw carrot, grated
- 1 c. chopped raw celery (optional)
- 4 tbsp. drained chopped pickles
- $\frac{3}{4}$ c. soft bread crumbs
- 2 tsp. salt
- pepper
- 3 onions, sliced

Biscuit dough

- $\frac{1}{2}$ c. sifted whole wheat flour
- $\frac{1}{2}$ c. sifted pastry flour
- 2 tsp. baking powder
- $\frac{3}{4}$ tsp. salt
- 3 tbsp. fat
- $\frac{1}{2}$ c. milk

1. Dredge liver in seasoned flour after cutting into pieces suitable for serving 2" x 2" x $\frac{1}{4}$ ".
2. Brown in fat.
3. Thicken gravy with 2 tbsp. flour and $\frac{1}{4}$ c. water.
4. Add carrot, celery, pickles and bread crumbs to gravy. Season with salt and pepper.
5. In a greased casserole (2 qt. size) arrange alternate layers of liver, sliced onions and gravy mixture.
6. Cover and bake in a moderate oven 350°, 45 minutes.
7. Top with shapes cut from biscuit dough. (For biscuit method see "Baked Liver Rolls" previous). Bake uncovered in hot oven 400° until biscuits are cooked, about 20-30 minutes longer. Serves 5-6.

CORNISH PASTIES

- $\frac{1}{2}$ lb. raw liver, diced
- 3 small raw potatoes, diced
- 1 minced onion
- salt
- pepper
- 1 c. sifted pastry flour
- $\frac{3}{4}$ c. sifted whole wheat flour
- $\frac{1}{8}$ tsp. salt
- 6 tbsp. fat
- water

1. Mix liver, potatoes and onion together and season with salt and pepper.
2. Sift flours and salt. Cut in fat and when well blended add sufficient water to make dough, as for pastry.
3. Place dough on floured board and roll $\frac{1}{4}$ " thick.
4. Cut into squares or circles and place a little of the meat mixture on half of each.
5. Fold dough and press edges together.
6. Bake in a slow oven 325°, about 1 hour. Serves 6.

NOTE: Try this recipe with leftover meats.

BRAISED PORK LIVER WITH VEGETABLES

- 1 lb. pork liver sliced
- $\frac{1}{2}$ " thick
- $\frac{1}{4}$ c. flour
- $\frac{3}{4}$ tsp. salt
- $\frac{1}{8}$ tsp. pepper
- 4 tbsp. fat
- 2 carrots, diced
- 6 raw potatoes, sliced
- $\frac{1}{4}$ " thick
- 1 onion, diced
- 1 c. tomato juice
- 1 c. boiling water or vegetable stock

1. Cut liver in 1" squares.
2. Roll in combined flour, salt and pepper and brown in fat.
3. Remove liver from fat. Put carrots, potatoes, and onion into pan. Brown slightly.
4. Add liver, tomato juice and water to vegetables. Cover and simmer gently on top of range, 1 $\frac{1}{2}$ hours. Thicken gravy if desired. Serves 6.

PORK LIVER WITH SPANISH SAUCE AND LIMA BEANS

- 1/2 lb. pork liver cut in 1/2" slices
- 2 tbsp. seasoned flour,
- 1 small onion thinly sliced
- 2 tbsp. fat
- 2 c. cooked tomatoes
- 1/2 tsp. salt
- 2 c. cooked lima beans or navy beans

1. Dredge liver with seasoned flour.
2. Brown onion and liver in fat.

3. Add tomatoes and 1/2 tsp. salt.
4. Cover and cook slowly 20-30 minutes.
5. Serve over hot beans. Serves 4-6.

To cook beans.

1. Soak 2/3 c. dried beans overnight in cold water.
2. Cook in soaking water until tender. Lima beans—30-40 minutes or 10 minutes in pressure cooker. Navy beans — 1 1/2 hours or 40 minutes in pressure cooker.

KIDNEY STEW

- 2 beef kidneys (about 1 1/2 lb.)
- 1/4 c. flour mixed with 2 tsp. salt
- 2 tbsp. fat
- 4 tbsp. chopped onion
- 2 c. water
- 1 tsp. salt
- 1/8 tsp. pepper
- 2 tbsp. vinegar

1. Split kidneys and remove all fatty tissue. Cut in 1" pieces and soak for 1 hour in cold salted water. Drain.

2. Roll kidneys in seasoned flour.
3. Brown slowly in fat.
4. Add onions and brown.
5. Add water, cover and simmer 1 1/2 hours or cook in pressure cooker, 15 minutes.
6. If necessary, thicken with 1 tbsp. flour mixed with 2 tbsp. water.
7. Season with salt and pepper and add vinegar. Serves 6.

STUFFED HEART *"Good hot or cold."*

- 1 beef, 2 veal or 4 lamb hearts

Dressing

- 2 c. soft bread crumbs or cubes
- 1/2 tsp. salt
- 1/8 tsp. pepper
- 1 tsp. sage
- 1/2 tbsp. chopped parsley
- 1 tbsp. chopped onion browned in 3 tbsp. fat.

- seasoned flour
- fat

- 1 1/2 c. water or vegetable stock

Alternate method for oven braising.

1. Reduce liquid to 1/2 c.
2. Prepare as above but cook, covered, in slow oven 300° instead of simmering. Allow 1 1/2-2 1/2 hours for lamb, pork or veal hearts; 3-4 hours for beef hearts.

Alternate method for pressure cooker.

1. Reduce liquid to 1 c.
2. Prepare as above but cook in pressure cooker, 50-60 minutes for beef heart, 25-35 minutes for veal, pork or lamb. Cool pressure cooker gradually.

HEART GOULASH

"Was all that heart eaten yesterday?"

- 1 c. chopped cooked heart
- 1 c. chopped cooked pork
- 3 tbsp. chopped onion
- 1 tbsp. fat
- 1 c. heart stock or vegetable stock
or water
- 1 1/4 tsp. salt
- 1/2 c. diced carrot
- 3 tbsp. chopped celery
(optional)
- 1/2 c. canned tomatoes or
tomato juice
- 1/2 c. sour cream or 1/4 c.
Worcestershire Sauce
- 2 tbsp. flour
- 2 tbsp. cold water
- 2 1/2 c. cooked rice or noodles

- 1. Brown heart, pork and onion in fat.
- 2. Add water, salt, carrots and celery.
Cook until vegetables are tender,
about 20 minutes.
- 3. Add tomatoes and cream or Worces-
tershire Sauce.
- 4. Mix water and flour to a smooth paste
and add to meat mixture. Cook slow-
ly.
- 5. Serve with rice or noodles.
Serves 5-6.

OXTAIL STEW

- 1 oxtail (about 1 1/2 lb.)
flour
- 2 tbsp. fat
- 3 c. vegetable stock or water
- 2 1/2 c. (1-20 oz. can) tomato
juice
- 1 1/2 tsp. dry mustard
- 2 1/2 tsp. salt
- 4 potatoes, diced
- 2 onions, sliced
- 3 carrots, sliced
- 3 tbsp. flour
- 1/2 c. cold water
- 2 tbsp. finely chopped parsley
or chives

- 1. Cut oxtails at joints. Sift a little
flour over meat.
- 2. Melt fat in stew kettle and brown
oxtail.
- 3. Add vegetable stock or water. Simmer
2 1/2 hours.
- 4. Add tomato juice, mustard and salt.
Simmer 30 minutes.
- 5. Add potatoes, onions and carrots.
Simmer 20 minutes or until tender.
- 6. Thicken stew with flour mixed with
cold water. Stir until thick. Add
parsley or chives before serving.
Serves 6.

DO YOU KNOW

Do you know that for each cup of gravy desired you need 2 tbsp. flour and 2-4 tbsp. fat from the meat or roast? *Either* stir flour into the fat, brown slightly, and add the required amount of liquid, stirring until thickened; *or* add the liquid to the fat and stir in the flour made into a paste with cold water. Gentle heat and constant stirring until the sauce is thickened are gravy-making secrets.

Do you know that 1 lb. lean meat without bone or waste serves 4-5 people?

Do you know that smaller roasts of meat require more minutes per pound to cook than larger roasts?

MEAT



BARBECUE SAUCE

- 1 medium onion, chopped
- 2 tbsp. melted fat
- 2 tbsp. vinegar
- 2 tbsp. brown sugar
- 4 tbsp. lemon juice
- 1 c. catsup
- 3 tbsp. Worcestershire Sauce
- 1 tsp. prepared mustard
- $\frac{1}{2}$ c. water
- $\frac{1}{2}$ c. chopped celery
- salt
- f.g. red pepper

1. Brown onion in fat.
2. Add remaining ingredients.
3. Cover. Simmer 30 minutes.
Serve with spareribs, short ribs, pork chops, frankfurters, meat patties, etc.

MUSTARD SAUCE FOR LEFTOVER MEATS *"Try something new."*

- 2 c. scalded milk
- 4 tbsp. flour
- 4 tbsp. fat
- 1 tsp. salt
- $\frac{1}{4}$ tsp. pepper
- $\frac{1}{4}$ tsp. paprika
- 2-3 tbsp. dry or prepared mustard (taste while adding)

1. Blend flour, fat and seasonings in top of double boiler.
2. Add milk gradually, stirring constantly to make a smooth blend. Cook until thickened.
3. Add mustard cautiously, tasting between additions.
4. Add $1\frac{1}{2}$ -2 c. diced cooked meat such as beef, tongue, liver, pork or ham. Serve on noodles, rice, biscuits or toast. Serves 4-5.

CELERY SAUCE FOR LEFTOVER MEATS OR BASE FOR CASSEROLE DISH *"Please don't miss this."*

- 2 c. scalded milk
- 4 tbsp. flour
- 4 tbsp. fat
- 1 tsp. salt
- $\frac{1}{4}$ tsp. paprika
- $\frac{1}{4}$ tsp. pepper
- $1\frac{1}{2}$ c. finely chopped celery or $\frac{1}{2}$ tsp. celery seeds
- $\frac{1}{4}$ c. chopped parsley

1. Blend flour, fat and seasonings in top of double boiler.
2. Add milk gradually, stirring constantly to make a smooth blend. Cook until thickened.
3. When thick, simmer chopped celery or celery seeds in the sauce for 5 minutes, then add chopped parsley.
4. Add $1\frac{1}{2}$ -2 c. diced cooked meat. Serve on toast, biscuits, mashed potatoes, noodles or cooked rice. Serves 4-5.

ORGAN MEATS

 *These products are very rich in food value and should be used frequently in the family diet. The chief object in cooking organ meats is to keep or make them tender, retain or develop flavour and add richness since there is little fat. All organ meats are perishable and must be cooked immediately even if they are not served on that day.*

Brains and Sweetbreads

These organs are very tender and soft in consistency. For this reason and also since they will spoil quickly brains and sweetbreads must be precooked for later use.

(a) Precook

Simmer 15 minutes in water with 1 tsp. salt and 1 tbsp. vinegar or lemon juice for each quart of water. Drain. Drop into cold water to chill. Use at once or keep in refrigerator until needed.

When ready to use, remove covering membrane. This is easily done under cold water.

(b) Ways to use

1. Reheat in rich white sauce with mushrooms or in highly seasoned tomato sauce.

2. Dip in egg and crumbs and fry in small amount of fat until delicately browned.

3. Dip in melted butter and broil, about 20 minutes. (See method for broiling, page 14).

4. Dice into omelet.

5. Scramble with eggs.

6. Use in salads combined with diced raw vegetables and tart dressing.

7. Cream with chicken or veal.

8. Surround each piece with a bacon strip. Fasten with a toothpick. Broil 3-5 minutes on each side, until bacon is crisp and brains or sweetbreads are heated through.

Liver

Liver of all animals supplies excellent food nutrients. Pork and beef liver have more value than lamb and veal liver. Pork and beef liver are less tender and need to be made tender by cooking.

(a) Preparation

1. Scalding is not necessary for any kind of liver.

2. If liver is to be ground, it should be dropped into hot water and simmered for a few minutes. This makes grinding easier.

(b) Ways to cook

1. Beef and pork liver are adapted to braising methods. See page 26.

2. Liver may be combined with pastry or tea biscuit to make pasties or rolls. See pages 25 and 26.

3. Liver loaf, and casseroles with liver. See recipes pages 25, 26 and 27.

4. Lamb and veal liver may be broiled. Brush slices of liver, $\frac{1}{2}$ " to $\frac{3}{4}$ " thick, with melted butter or other fat. Broil 3 minutes on each side, or until colour is changed. See broiling page 14.

5. Lamb and veal liver may be fried. Roll slices of liver in seasoned flour. Brown both sides in a small amount of fat in frying pan. Reduce temperature until done.

Heart

For the method of preparation and ways to use heart, see pages 27 and 28.

Kidneys

Veal, pork, lamb and beef kidneys may all be very palatable.

(a) Preparation

1. Kidneys should be washed and split through the centre.

2. Beef and pork kidneys should be soaked in water before cooking.

3. The kidney tubes should be removed before cooking.

4. Marinating kidneys in a well-seasoned French dressing may improve flavour.

(b) Ways to cook

1. Veal, pork and lamb kidneys are delicious broiled. Either marinate kidneys in French dressing 1 hour or brush with melted butter and broil 5 minutes on

each side. See method for broiling, page 14.

2. Beef kidney should be cooked in water or braised. Simmer kidney in water to cover until tender, about 1 hour for beef kidney. Water should be changed several times during cooking.

3. Veal, pork and lamb kidneys may be simmered in water until tender, about 30-45 minutes.

4. For beef and kidney pie, see recipe page 23.

5. For kidney stew, see page 27.

6. Cooked beef kidneys may be served in well-seasoned sauce.

7. Cooked beef kidneys may be dipped in egg and crumbs and fried.

Tongue

Tongues may be fresh, pickled, canned or smoked. Like heart, tongue is a much used muscle and is less tender. To make

this meat tender is the principal object in cooking.

(a) Preparation

1. Fresh tongue should be well washed and scrubbed before using.

2. Pickled or smoked tongue should be soaked for several hours before cooking.

(b) Ways to use

1. Always use long slow cooking in moist heat for tongue, approximately 1 hour per pound.

2. After cooking trim the tongue and remove skin.

3. Serve hot or cold with a spicy sauce.

4. To reheat tongue, heat it in the liquid in which it was cooked.

5. Jellied tongue may be prepared by adding 1 onion, 1 tbsp. whole cloves and 2 bay leaves while simmering. When tongue is tender, strain the liquid and pour over 2 tbsp. gelatine dissolved in $\frac{1}{2}$ c. cold water. Bring liquid to the boil and pour over tongue in a mould. Chill.

HAVE YOU TRIED ALL THESE **LEFTOVER** MEAT SUGGESTIONS?



Order your meat carefully and use the leftovers skilfully. Give new wrinkles to old ideas!

FOR SLICES

1. Reheat slices of meat in gravy or tomato, barbecue or sour cream sauce.
2. Serve slices cold with hot vegetables or salad greens.
3. Use in sandwiches. Use with gravy in hot sandwiches.

DICED

1. Add diced meat to white sauce, celery, mustard or other sauce. Allow 1 cup sauce for each cup meat. Serve on toast, with rice, with noodles or over hot biscuits. Horseradish may be used to flavour the white sauce.
2. Make into meat pies, turnovers or Cornish Pasties.
3. Use in casserole dishes with extender such as spaghetti, macaroni, noodles or mixed vegetables. 1 cup diced meat, 2 cups sauce, 2 cups extender, $\frac{1}{4}$ cup cheese added to the sauce is good. Vary this by baking with a mashed potato topping at 350° or use baking powder biscuit topping and bake at 425°, 15-20 minutes.
4. Combine diced meat with diced vegetables and salad dressing for salads.

GROUND

1. Make into hash, baked or fried.
2. Make into hash folded like an omelet and filled with barbecue or other seasoned sauce.
3. Use as sandwich filling with salad dressing, pickles, nuts or celery.
4. Use as stuffing for vegetables:—tomatoes, peppers, onions, cabbage, potatoes.
5. Use in meat loaf, croquettes, salad.



SALMON LOAF WITH CHEESE

- 2 c. cooked salmon, flaked
- 1½ c. grated cheese
- 1 egg, well beaten
- 3 tbsp. milk
- 1 tbsp. fat
- ½ tsp. salt
- pepper
- cracker or bread crumbs

1. Combine ingredients, using enough crumbs to obtain a stiff mixture.
2. Press into a greased loaf pan 9" x 5" x 3". Cover with buttered crumbs and bake in oven 375° until golden brown, about 45 minutes. Serve hot or cold. Serves 6.

FISH BALLS

- 1 c. fish
- 1½ c. mashed potatoes
- 1 egg, beaten
- 1 tbsp. fat, melted
- salt and pepper to season
- ½ tsp. chopped onion

1. Mix ingredients well, beating until fluffy.
2. Form into balls or cakes and roll in finely sifted, dry bread or cracker crumbs.
3. Saute in a small amount of fat until browned and well heated. Egg, tomato or white sauce may be served with balls. Serves 4-5.

FISH SOUFFLE

- 1 c. scalded milk
- 3 tbsp. flour
- 3 tbsp. fat
- ½ tsp. salt
- 3 eggs, separated
- 1½ c. cooked flaked fish or canned salmon
- ½ c. cooked peas (optional)

1. Blend flour, melted fat and salt. Add milk slowly. Stir while cooking, until smooth and thick.
2. When white sauce is slightly cool, add egg yolks, stirring as they are added and beat well.

3. Add fish and peas.
4. Beat egg whites until stiff but not dry. Fold egg white into the other ingredients.
5. Pour into greased casserole (1½ qt.) and place casserole in a pan of hot water. Bake in moderate oven 350°, 35-40 minutes. (A knife inserted in the centre of souffle will come out clean when the souffle is done). Canned or leftover fish (boiled, baked or steamed) may be used. Serves 5-6.

FISH CHOWDER

- ⅔ c. grated or minced onion
- 3 tbsp. melted fat
- 2 c. raw diced fish
- 2 c. raw diced or grated potatoes
- 1 c. chopped celery (optional)
- salt and pepper
- 4 c. water
- 4 c. milk

1. Lightly brown onion in fat.
2. Add fish, potatoes and celery. Cook a few minutes. Season well. Add cold water and cook until tender.
3. Add cold milk and heat to boiling. Serve very hot. Serves 6-8.

V VEGETABLES



GONE are the days when we ate meat and potatoes three times a day. Now we add a variety of succulent vegetables in many shapes and sizes and find that we are enjoying better meals and incidentally, better health. And don't let Grandpop tell you any different! How can you help feeling better when you are stoking up with extra vitamins and minerals supplied by those oh-so-good vegetables? I just wish I had a fresh cob of corn right now! With lots of butter and salt? Mmm Mm!

GROW YOUR OWN

We all know that *fresh* vegetables, straight from the garden, taste extra good and are extra good for us. To grow her own vegetables should be the aim of every rural housewife. Straight-from-the-garden vegetables have the greatest nutritive value, the best flavour, texture and appearance. Many different kinds of vegetables should be grown in each garden. Variety makes gardening a more interesting project and some vegetables contain more of certain vitamins and minerals than others. Too, it teaches the family to know and like such delectable vegetables as Swiss chard, squash, vegetable marrow and soybeans as well as the old standbys, carrots, onions, turnips, peas and beans. It is a good idea to stagger the planting time of peas, beans, lettuce, carrots and beets.

Do grow sufficient vegetables to enable you to serve them every day in season and to preserve your winter requirement.

Ask your Agricultural Representative's advice on your gardening problems.

PRESERVING YOUR HOME-GROWN VEGETABLES FOR WINTER USE

THE smart homemaker will make sure that many of her garden vegetables are conserved for winter use. Canning, freezing and storage are the common methods used in Ontario to preserve the garden crop. Each of these methods of food preservation is a study in itself. We would like to emphasize that you can save yourself time and perhaps the disappointment of unsatisfactory results by obtaining the latest information on these subjects. Bulletins containing reliable information on canning and freezing may be obtained upon request from the Ontario Department of Agriculture, Toronto. Bulletins on the household storage of fruits and vegetables are obtainable from the Dominion Department of Agriculture, Ottawa. This information is free and yours for the asking. Make use of it!



WHEN YOU MUST BUY VEGETABLES— BUY WISELY

DO shop in person for vegetables. You may get better quality for the money you spend. Ordering by telephone often proves expensive.

* * *

DO buy vegetables by weight and not by measure.

* * *

DO know the comparative values of fresh, canned and frozen vegetables. Know brands and grades. Canned vegetables are graded for your protection. Do you buy "fancy" grades when "choice" or "standard" grades would serve your purpose equally well? Do you notice the number of ounces which a tin or carton contains?

DO buy local vegetables in season. Out-of-season vegetables, such as hot-house tomatoes and celery are expensive luxuries in January.

* * *

DO buy as "fresh-from-the-garden" vegetables as possible. Fresh vegetables lose Vitamin C during storage, especially at room temperature. For example, wilted spinach may have lost two-thirds of its Vitamin C.

Leafy vegetables such as spinach, Swiss chard, leaf lettuce, must be crisp.

Peas and beans must have crisp tender pods.

Carrots, turnips, potatoes must be firm and not sound hollow when tapped.

Buy Vegetables Wisely — Store Carefully — Cook Skilfully

DAY-TO-DAY STORAGE

► *If vegetables for immediate use cannot be cooked as soon as gathered or purchased, they must be stored properly. A little special care in storage will help to retain the texture, flavour and food value of your vegetables.*

Trimming. For temporary storage, such vegetables as peas, corn and cauliflower should be left in their natural state — peas in the pod, corn in the husk, cauliflower in surrounding green leaves.

Some agricultural experts find that as root vegetables stand with tops on, moisture is drawn from the roots to the leaves. In view of this fact it would be advisable to store root vegetables with tops removed.

Such vegetables as lettuce, spinach, chard and celery are best trimmed of imperfections and washed of excess sand before storage.

Keep vegetables cold. Even vegetables which do not spoil quickly are best stored in a *cold place*. At room temperature many vegetables lose their Vitamin C rapidly. A temperature of 40° F. — 50° F. is best for most vegetables. Squash and sweet potatoes are best stored at a slightly higher temperature 50° F. — 60° F.

Most vegetables keep best in a moist atmosphere. Otherwise the natural moisture of the vegetables is lost to the air and wilting and withering result. The covered pan or "crisper" of a refrigerator is a convenient storage place for asparagus, beans, peas, tomatoes and leafy green vegetables. Cellophane bags in which many foods are purchased nowadays can be used to advantage for covering many vegetables.

Onions and dried beans and peas should be stored in a *dry place*.

Darkness is preferable to light for vegetable storage.

Storage of canned vegetables. Keep canned vegetables cold, but avoid freezing. Freezing impairs the palatability of canned vegetables but does not make the food unfit for consumption provided the tin has not been broken. If glass is used, store in a cold, dark place.

Storage of frozen vegetables. Keep frozen vegetables in a zero freezing com-

partment until ready for use. Cook in frozen state. Do not refreeze thawed vegetables.

Storage of dried vegetables. Keep dried vegetables in an air-tight, moisture-proof container, in a cool dry place.

COOK VEGETABLES SKILFULLY

In cooking vegetables, the aim is to preserve the most nutritive value and at the same time produce a cooked vegetable that is perfect in colour, flavour and texture.

A word to the wise: don't overcook vegetables. Nothing can spell such utter ruin to a vegetable as overcooking. Not only does it spoil the vegetable from an eating standpoint, but also from a health standpoint.

PREPARATION

1. Select vegetables that are fresh, firm, sound and uniform in size for cooking.
2. Remove insects by placing in cold water to which salt or vinegar has been added.
3. Wash thoroughly. Use a vegetable brush for root vegetables.
4. Pare carefully, for much of the mineral content lies near the surface. Scraping removes less of the minerals than paring. *Leave skins on potatoes.*
5. Do not leave pared vegetables standing in cold water. Prepare and cook immediately.
6. Keep green salad vegetables in the crisping pan of the refrigerator or in a cold place until you are ready to use them.
7. Wash dried vegetables (beans, peas, lentils, etc.) very thoroughly and soak in plenty of water for at least twelve hours. Cook in the soaking water.

COOKING FRESH VEGETABLES



- I BOILING.
- II STEAMING.
- III BAKING.
- IV PRESSURE COOKING.
- V WATERLESS COOKING.

I BOILING

Boiling is the most common method of vegetable cookery. Anyone can boil water but a few tips on boiling vegetables may not be out-of-order since the real value of the cooked vegetable will depend on how you do the job.

(A) *Mild flavoured vegetables* — potatoes, carrots, fresh beans, fresh peas, parsnips.

1. Use a small amount of boiling water, $\frac{1}{2}$ "-1" deep, in a saucepan.
2. Drop vegetables into boiling water, cover tightly and bring back to the boil as quickly as possible. This shortens the cooking time and less minerals and vitamins will be dissolved out of the vegetables. Keep water boiling throughout cooking period.
3. DO NOT OVERCOOK VEGETABLES. OVERCOOKING IMPAIRS COLOUR, FLAVOUR AND TEXTURE. OVERCOOKING CAUSES GREAT LOSS OF MINERALS AND VITAMINS.
4. Drain well and season. Always save the vegetable water. It contains valuable vitamins and minerals which have dissolved from the vegetable. Use vegetable water (vegetable stock) in soups, sauces, stews and gravies.
5. Serve at once.

There is a great loss of Vitamin C from mashing. It is best not to mash potatoes or turnips.

(B) *Strong flavoured vegetables* — onions, turnips, cabbage, cauliflower, Brussels sprouts. Use the same me-

thod as for mild flavoured vegetables. If vegetables have a *very* strong flavour, a larger amount of water may be used and the cover may be removed after the water returns to the boil.

(C) *Leafy green vegetables*

1. Use a very small amount of water. Usually the water that clings to the leaves after washing is sufficient.
2. Place in a saucepan with tightly fitting lid.
3. Steam-boil over moderate heat until kettle is filled with steam.
4. Lower heat, maintain steam and cook until vegetable is tender, 5 to 15 minutes, depending on the type and age of vegetable.
5. Drain well and season.
6. Serve at once.



II STEAMING

Steaming is an excellent method of cooking mild flavoured vegetables. Strong flavoured vegetables do not take kindly to this treatment and are generally not satisfactory in flavour when cooked by this method.

1. Place prepared vegetables in perforated pan of steamer over boiling water.
2. Cover tightly and adjust heat to keep water boiling.
3. Cook until tender (about one and a half times as long as boiling). Do not overcook.
4. Season.
5. Serve at once.

III BAKING

Baking is another excellent method of cooking vegetables. Almost every type of vegetable except the leafy greens and certain other green vegetables can be baked.

1. All vegetables except potatoes should be baked in a moderate oven. Potatoes require a hot oven, 425°.
2. Bake vegetables in their skins when possible.
3. Bake whole vegetables such as onions and tomatoes uncovered.
4. Carrots, beets and parsnips may be cut or grated, put in a closely covered greased baking dish with seasoning and sufficient water to keep from drying.
5. Serve at once.



IV PRESSURE COOKING

The pressure cooker does an excellent job in saving time and fuel. Owing to the high temperatures involved, great care should be taken not to overcook your vegetables.

1. Prepare vegetables as for boiling or steaming.
2. Place in cooker with small amount of water, $\frac{1}{4}$ c. to $\frac{1}{2}$ c.
3. Close the cover according to manufacturer's directions. Learn to judge the time required to cook vegetables by this method. Take into consideration the size of pieces and the age of the vegetable. Keep a record for future use. Use manufacturer's directions as a guide. Do not overcook.
4. Serve at once.



V WATERLESS COOKING

Waterless cookers are specially constructed, heavy pots with close fitting lids in which little water (2 tbsp. - 4 tbsp.) is required and from which very little steam escapes during cooking. This is generally considered to be a very satisfactory method of vegetable cookery.

COOKING CANNED VEGETABLES

1. Drain the liquid from the can and heat to boiling.
2. Add vegetable and heat through. Do not prolong the cooking.
3. Serve at once.
4. Make use of the vegetable juice.



COOKING FROZEN VEGETABLES

1. Frozen vegetables except corn on the cob should be cooked without defrosting in a small amount of boiling water.
2. Cover tightly.
3. The cooking time of frozen vegetables is shorter than fresh vegetables. Do not overcook.
4. Serve at once.



Canada's Food Rules say that we must have "At least one serving of potatoes; at least two servings of other vegetables, preferably leafy, green or yellow, and frequently raw."

SO, please do not neglect your salads. Use plenty of raw cabbage. There are endless variations of cabbage salad! Use plenty of raw turnip too. Grate your raw turnip for salads *the last minute before serving your meal*. It tastes better that way and it's better for you too!

Do you know that a booklet with recipes of salads and salad dressings called "Salads—All the Year 'Round" may be obtained on request from the Women's Institute Branch and Home Economics Service, Ontario Department of Agriculture, Toronto?

COOKING GUIDE FOR VEGETABLES CHART IV.

VEGETABLE	<i>Boiling Minutes</i>	<i>Baking Minutes</i>	<i>Steaming Minutes</i>	<i>Pressure Cooking Minutes</i>
Asparagus	5-15			1-2
Beans, green or wax, 1" pieces	15-30		30	3-4
Beets, whole new	30		45-60	15-20
whole, old	40-60	grated 50 at 350°	60-90	20
Beet greens	5-15			
Brussels sprouts	8-15			2-3
Broccoli, cut lengthwise	8-15			2-3
Cabbage, wedges (better method of preparation)	15			2-4
finely cut	5-10			1-2
Carrots, small, whole	15-20		20-30	3-4
large, quartered	15-20	grated 30-40 at 350°	20-30	2-4
Cauliflower, flowerets	8-10			2
Celery, 1" pieces	15-25			2-3
Corn on cob	5-12		12	3-5
Kale	10-20			
Onions, whole	20-30	45-60 at 350°		5-7
Parsnips, quartered	20	grated 30-40 at 350°	30	6-7
Peas, green	10-20		25	1-2
Potatoes, white, whole	20-40	40-60 at 425°	30-45	10-15
Spinach	5-10			1-2
Squash, 1½" cubes	20		30	
individual servings		30-60 at 350°	30-60	4-8
Sweet potatoes or yams, whole	20-45	25-60 at 425°	25-60	
Swiss chard	5-15			2-3
Tomatoes	5-10	20-30 at 350°		
Turnips, white, ½" slices	10-15			3
yellow, ½" cubes	20-30			3

ASPARAGUS CASSEROLE

To buy fresh or canned asparagus for this dish would be expensive. But for those who have frozen or canned asparagus, it makes a delightful way to serve that vegetable and is especially good for using up cuttings or broken tips.

- 3 c. freshly cooked or canned asparagus
- 3 tbsp. fat
- 6 tbsp. flour
- asparagus liquid, made up to 2 c. with milk
- $\frac{1}{2}$ c. grated Canadian cheese
- $\frac{1}{2}$ tsp. salt

TOPPING

- $\frac{1}{3}$ c. dry whole wheat bread crumbs
- 2 tbsp. wheat germ
- 1 tbsp. fat, melted

1. Place asparagus in a greased casserole or baking dish about 7 $\frac{1}{2}$ " in diameter and 3 $\frac{1}{2}$ " deep.
2. Melt fat, blend in flour.
3. Stir in the liquid slowly and cook in a double boiler until thickened, stirring constantly.
4. Add salt and grated cheese to sauce. Stir until cheese is melted and blended.
5. Pour the sauce over asparagus.
6. Mix bread crumbs, wheat germ and melted fat. Sprinkle over top.
7. Bake in a slow oven, 325°, 30 minutes. Serves 6-8.

HOT MAYONNAISE

This sauce is good on asparagus, cauliflower, peas and broccoli.

- 4 tbsp. flour
- 1 tbsp. granulated sugar
- 2 tsp. dry mustard
- $\frac{1}{4}$ tsp. salt
- $\frac{1}{8}$ tsp. paprika
- $\frac{1}{4}$ c. salad oil
- 1 c. milk or asparagus liquid
- 1 egg, well beaten
- $\frac{1}{4}$ c. vinegar

1. Mix flour, sugar, salt, mustard and paprika in top part of the double boiler.
2. Add salad oil and mix until smooth.
3. Gradually stir in the milk or asparagus liquid.
4. Place over hot water and cook, stirring constantly until mixture thickens.
5. Cover and cook 5 minutes, stir occasionally.
6. Combine egg and vinegar.
7. Stir into cooked mixture. Continue cooking, stirring constantly for 3 minutes.

ASPARAGUS WITH HOT MAYONNAISE

- 4 c. freshly cooked or canned asparagus
- 1 recipe hot mayonnaise
- paprika

1. Pour hot mayonnaise over hot asparagus.
2. Sprinkle with paprika and serve. Serves 6-8.

BAKED BEET CASSEROLE

- 4 tbsp. flour
- 2 tbsp. fat
- 1 c. liquid from canned beets
or if home-cooked beets are
used — 1 c. water
- 4 tbsp. brown sugar
- $\frac{1}{4}$ tsp. salt
- $\frac{1}{2}$ tsp. celery salt
- 3 tbsp. horseradish
- 4 c. cooked beets, diced, canned
or home-cooked

TOPPING

- $\frac{1}{4}$ c. dry whole wheat bread
crumbs
- 1 tbsp. wheat germ
- 1 tbsp. fat, melted

1. Blend flour and fat.
2. Stir in beet liquid or water gradually.
3. Cook in double boiler, stirring constantly until thickened.
4. Add sugar, salt, celery salt, horseradish and beets. Mix well.
5. Pour into greased casserole or baking dish about 7 $\frac{1}{2}$ " in diameter and 3 $\frac{1}{2}$ " deep.
6. Mix bread crumbs, wheat germ and melted fat. Sprinkle over beet mixture.
7. Bake in moderate oven 350°, 20 minutes. Serves 6-8.

BAKED CARROTS

- 3 c. carrots, grated
- 1 tsp. salt
- pepper
- $\frac{1}{2}$ c. water

1. Place ingredients in greased casserole, 1 $\frac{1}{2}$ qt. size.
 2. Cover and bake in moderate oven, 350°, 20-30 minutes.
- Serves 6.

BAKED BEETS

- 5 medium sized young beets
- 1 tsp. salt
- $\frac{1}{4}$ tsp. celery salt
- 2 tbsp. brown sugar
- 6 whole cloves
- $\frac{1}{2}$ tbsp. horseradish
(optional)
- 1 tbsp. malt vinegar
- $\frac{3}{4}$ c. water

NOTE:—Beets in this sauce may be cooked in the Pressure Cooker. Slice the raw beets instead of shredding them. Cook 20 minutes at 15 lb. pressure.

1. Wash beets very well.
2. Pare.
3. Grate on a medium shredder.
4. Mix salt, celery salt and brown sugar.
5. Stir in horseradish, vinegar, water and cloves.
6. Mix well with shredded beets.
7. Place in a greased casserole or baking dish, 7 $\frac{1}{2}$ " in diameter and 3 $\frac{1}{2}$ " deep. Cover closely.
8. Place in a moderate oven 350° and bake 50 minutes.

DO YOU KNOW

Do you know that it pays to cook potatoes in their jackets? Cooked in this way, potatoes retain more of their food value. It saves time too.

Do you know that all dried beans and peas (except soybeans) should be cooked in the water in which they have soaked overnight? Soybeans have better flavour when they are cooked in fresh water and better flavour still when cooked in meat stock. Don't cook beans any longer than necessary.

CORN AND LIMA BEAN CASSEROLE

- 2 c. cooked lima beans
- 2 c. cream corn
- 1 tbsp. finely chopped onion
- $\frac{1}{2}$ tsp. salt
- $\frac{1}{2}$ tsp. celery salt
- $\frac{1}{3}$ c. dry whole wheat bread crumbs
- 1 tbsp. fat, melted

- 1. Mix lima beans, corn, onion, salt and celery salt together.
- 2. Put in a greased casserole or baking dish, $7\frac{1}{2}$ " in diameter and $3\frac{1}{2}$ " deep.
- 3. Cover with bread crumbs which have been moistened with melted fat.
- 4. Bake in a moderate oven 375° until the mixture is heated through and the topping is brown, about 30 minutes.
- 5. The addition of $\frac{1}{2}$ c. chopped green pepper is acceptable. Serves 6.

GRATED PARSNIP CASSEROLE

- 4 c. raw parsnips, grated
- 2 tbsp. fat, melted
- 1 tbsp. brown sugar
- 1 tsp. dry mustard
- $\frac{1}{2}$ tsp. salt
- $\frac{3}{4}$ c. water

- 1. Place ingredients in greased casserole $1\frac{1}{2}$ qt. size.
- 2. Cover and bake in moderate oven 350° , 30 minutes.
- Serves. 6.

BAKED PARSNIPS

- 4 c. diced cooked parsnips
- 2 tbsp. fat, melted
- 2 tbsp. brown sugar
- $\frac{1}{2}$ tsp. salt
- 1 tsp. dry mustard
- 1 tbsp. dry whole wheat bread crumbs
- a little water

- 1. Place parsnips in a greased casserole or baking dish, $7\frac{1}{2}$ " in diameter and $3\frac{1}{2}$ " deep.
- 2. Pour melted fat over parsnips.
- 3. Mix sugar, salt, mustard and bread crumbs. Add just sufficient water to moisten.
- 4. Sprinkle over parsnips.
- 5. Bake in moderate oven 375° , 20 minutes. Serves 6-8.

ONION AND APPLE CASSEROLE

- 4 medium sized onions
- $1\frac{1}{2}$ tsp. salt
- 2 tbsp. brown sugar
- 1 c. dry whole wheat bread crumbs
- 2 tbsp. wheat germ
- 2 tbsp. fat, melted
- 4 medium sized tart apples
- 1 tbsp. vinegar
- $\frac{1}{2}$ c. water

- 1. Slice onions and parboil.
- 2. Mix salt, sugar, bread crumbs and wheat germ with melted fat.
- 3. Arrange alternate layers of sliced apples, onions and bread crumbs in greased casserole, $7\frac{1}{2}$ " in diameter and $3\frac{1}{2}$ " deep. (Have bread crumb mixture as the topping).
- 4. Add vinegar and water.
- 5. Bake in moderate oven 350° , 45 minutes. Serves 6.

UPSIDE-DOWN VEGETABLE CAKE

- 1 c. whole wheat flour
- $\frac{3}{4}$ c. all purpose flour
- 2 tsp. baking powder
- $\frac{3}{4}$ tsp. salt
- $\frac{1}{4}$ c. wheat germ
- $\frac{1}{3}$ c. shortening
- 1 egg, beaten
- 1 c. vegetable stock (pea and carrot)
- 4 c. cooked mixed vegetables (2 c. peas, 1 c. carrots, 1 c. cooked kidney, lima or navy beans)
- $\frac{1}{2}$ c. vegetable stock
- 2 tbsp. fat

1. Mix and sift flours, salt and baking powder.
2. Mix in the wheat germ.
3. Cut in the shortening.
4. Combine beaten egg and 1 c. vegetable stock, add to dry ingredients and stir until mixed.
5. Arrange hot seasoned vegetables in the bottom of a greased casserole, $1\frac{1}{2}$ qt. size. Add $\frac{1}{2}$ c. vegetable stock. Dot with fat.
6. Cover the vegetables with the first mixture.
7. Bake in a hot oven 425° , 25 minutes.
8. Serve with hot Tomato or Mushroom Sauce.

Serves 6-8.

BAKED POTATOES

1. Scrub, eye and rinse medium sized potatoes.
2. Grease skins lightly.
3. Bake at 425° until tender, 40-60 minutes.
4. When soft, crack or cut the skin to allow the steam to escape.

DO YOU KNOW

Do you know that adults as well as children need milk?

Do you know that one-half pint of milk is the *minimum* amount of milk recommended daily for adults?

Do you know that no beverage tastes better than good cold milk?

Do you know that milk cannot be considered a "fattening" food? If you are watching your Calories, frequently use buttermilk or skimmed milk.

Do you know that Canadian cheddar cheese is good food? Serve it often!

SUPPER SPECIALTIES



"SOMETHING old and something new"—in the way of recipes for supper, that third meal so difficult to plan. Perhaps you will be inspired to create dishes of your very own, making use of those leftovers.

Have you heard about the wonderful soybean? It packs a punch full of *good* nutrition. It's worth your while to search it out and use it often. Don't forget the other types of beans; they are good, low-cost meat substitutes.

SOYBEANS IN CASSEROLE

- | | |
|---|--|
| 1 c. soybeans | 1. Wash and soak soybeans overnight in cold water. Drain. |
| 3 c. boiling water plus 2 bouillon cubes or 3 c. meat stock | 2. Cook soybeans in meat stock until tender: about 3 hours in saucepan or 25 minutes in pressure cooker. |
| 6 tbsp. flour | 3. Drain and measure stock. If necessary, add hot water or tomato juice to make up 2 c. liquid. |
| $\frac{1}{8}$ tsp. pepper | 4. Mix flour, pepper, mustard and cold water and thicken the stock. |
| 1 tsp. mustard | 5. Saute until lightly brown the fat pork, onion, celery and green pepper. |
| $\frac{1}{2}$ c. cold water | 6. Add to stock and add molasses or sugar and salt to taste. |
| $\frac{1}{4}$ lb. diced salt pork or bacon | 7. Add soybeans and turn into greased casserole ($1\frac{1}{2}$ qt. size). |
| $\frac{1}{4}$ c. diced onion | 8. Bake uncovered in preheated moderate oven 350° , 30 minutes. |
| 1 tbsp. molasses or sugar | Serves 6-8. |
| 1 tsp. salt | |
| $\frac{1}{4}$ c. diced celery | |
| 2 tbsp. green pepper | |
| } optional | |

ECONOMY STEW

"Featuring navy beans."

- 1 c. or $\frac{1}{2}$ lb. dried navy beans
- $\frac{1}{4}$ lb. bacon
- 2 onions, sliced
- $1\frac{1}{2}$ tsp. salt
- $\frac{1}{8}$ tsp. pepper
- $\frac{1}{2}$ bay leaf
- 1-28 oz. tin or $3\frac{1}{4}$ c. tomatoes
- $1\frac{1}{2}$ c. water
- 1 c. raw potatoes, diced
- $\frac{1}{2}$ green pepper diced (if available)

1. Soak beans overnight in cold water.
2. Fry bacon and onions.
3. Add to beans, bacon and onions, salt, pepper, bay leaf and tomatoes. Cook until beans are almost tender (about $1\frac{1}{2}$ hours).
4. Add water, diced potatoes, green pepper and continue cooking until all ingredients are tender (about 20 minutes).

NOTE—If pressure cooker is used:

1. Soak beans overnight in cold water.
2. Fry bacon and onions in bottom of pressure cooker.
3. Add beans, salt, pepper, bay leaf, tomatoes and water.
4. Cook for 30 minutes, reduce pressure, add potatoes and green pepper and cook another 10 minutes.
5. Cooked potatoes may be used instead of raw potatoes and should be added after cooking has been completed. Serve in deep bowls. Serves 6.

CHEESE AND LIMA CASSEROLE

"An American dish, but good for Canadians, too!"



- 2 c. dried lima beans
- $2\frac{1}{2}$ c. water
- $2\frac{1}{2}$ tsp. salt
- 1 tsp. sugar
- $\frac{1}{8}$ tsp. pepper
- $\frac{3}{4}$ c. chopped onions
- 1 c. canned tomatoes
- 1 tsp. Worcestershire Sauce
- 1 c. grated cheese

1. Pick over and wash lima beans. Soak overnight in water.
2. Heat soaking water to boil. Add salt, sugar, pepper and onions and cook covered until tender, 30-40 minutes.
3. Add tomatoes and Worcestershire Sauce.
4. Place in greased casserole ($1\frac{1}{2}$ qt. size). Cover with grated cheese.
5. Bake in moderate oven 350° , 30 minutes. Serves 6.

DO YOU KNOW

Do you know that $\frac{1}{2}$ lb. hard cheese yields 2 c. grated cheese?

Do you know that because a hot temperature toughens cheese, cheese should always be added to white sauce after it is removed from the heat?

SAVOURY MACARONI

"Another way of serving macaroni."

- 2 c. or 8 oz. uncooked macaroni
- 3 tbsp. fat
- 1/2 c. chopped onion
- 1 green pepper, cut into strips
- 1 3/4 c. canned tomatoes
- 1 c. grated cheese
- 2 tsp. salt
- 1/8 tsp. pepper
- 1 egg, beaten

TOPPING

- 2 tbsp. brown bread crumbs
- 1 tbsp. wheat germ
- 2 tbsp. grated cheese
- 1 tbsp. melted fat

1. Cook macaroni in boiling salted water about 25 minutes. Drain and rinse with cold water.
2. Melt fat in skillet. Add onions and green pepper and cook until soft.
3. Combine all remaining ingredients except egg and mix well.
4. Stir in beaten egg.
5. Pour into greased casserole (1 1/2 qt. size) and cover with topping.
6. Bake 30 minutes in moderate oven, 350°. Serves 4-6.

HAMBURGER AND MACARONI CASSEROLE

"Here's a good supper dish."

- 2 c. or 8 oz. uncooked macaroni
- 2 tbsp. fat
- 1 large onion
- 1/2 lb. hamburger
- 2 c. canned tomatoes
- 1 green pepper, diced (optional)
- 1 tsp. salt
- 1/8 tsp. pepper

TOPPING

- 2 tbsp. brown bread crumbs
- 1 tbsp. wheat germ
- 1 tbsp. melted fat

1. Cook macaroni in boiling salted water about 25 minutes. Drain and rinse with cold water.
 2. Cook onions and hamburger in fat.
 3. Add tomatoes, green pepper and macaroni. Mix well.
 4. Season with salt and pepper.
 5. Pour into greased casserole (1 1/2 qt. size) and cover with topping.
 6. Bake in moderate oven, 350°, 30 minutes.
 7. For additional flavour use:
 - 1/2 tbsp. Worcestershire Sauce or
 - 1/4 c. catsup—in hamburger mixture.
- Serves 5-6.

DO YOU KNOW

Do you know that cooked macaroni pieces will be separated and not sticky if cold water is poured through the macaroni after the hot cooking liquid is drained off?

CHILI CON CARNE No. 1

"Two versions of that old Mexican favourite, and good too!"

- 1 lb. beef steak, cut in small cubes
- 1 tbsp. fat
- 1 large onion, chopped
- 1-28 oz. tin or 3¼ c. tomatoes

- 2 c. cooked soybeans (1 c. dried)
- 1 tsp. salt
- 1 tbsp. chili powder
- paprika



1. Brown beef in fat.
2. Add onion, tomatoes and beans. Cook 1½ hours. Add boiling water if liquid boils away.
3. Add seasoning.
4. The gravy may be thickened if desired with 3 tbsp. flour mixed with ¼ c. cold water.
5. Serve with rice, noodles, macaroni, or mashed potatoes or on hot toast. Serves 6.

IN A PRESSURE COOKER

1. Soak soybeans overnight in water to cover.
2. Cook for 15 minutes in pressure cooker in water in which they were soaked.
3. Drain. Remove beans from cooker. Brown beef in melted fat in pressure cooker.
4. Add onion, tomatoes and drained beans and cook 15 minutes.
5. Add seasoning.
6. The gravy may be thickened if desired with 3 tbsp. flour mixed with ¼ c. cold water.

CHILI CON CARNE No. 2

- ¼ c. finely chopped onion
- 2 tbsp. fat
- 1 lb. round steak, ground
- 1 tbsp. Worcestershire Sauce
- 1 tbsp. chili powder or ½
- tbsp. chili and ¼ tsp.
- cayenne
- hot water
- 1-20 oz. tin kidney beans or
- 2¼ c. home-cooked beans
- 2 tsp. salt
- 1 tbsp. flour
- 4 c. tomatoes

1. Brown onion in the fat.
2. Add meat, Worcestershire Sauce, chili powder and combine thoroughly.
3. Add enough hot water to almost cover.
4. Simmer until tender, add remaining ingredients, blending the flour with a little tomato juice.
5. Cook gently until the mixture is thoroughly blended and a pleasing consistency.
6. Serve hot with boiled or steamed rice. Serves 6.

ITALIAN DELIGHT

"Italian Delight — and ours too!"

- 1 tbsp. salt
- 3 qt. boiling water
- 1 $\frac{1}{4}$ c. or 4 oz. medium noodles
- 2 tsp. fat
- 2 tbsp. chopped onion
- 2 tbsp. chopped parsley
- $\frac{1}{4}$ lb. ground beef
- 2 $\frac{1}{2}$ c. cooked tomatoes
- $\frac{1}{2}$ c. kernel corn or peas
- $\frac{1}{4}$ c. catsup
- 1 tbsp. Worcestershire Sauce
- 1 tsp. salt
- pepper

TOPPING

- 2 tbsp. brown bread crumbs
- 1 tbsp. wheat germ
- 1 tbsp. melted fat

1. Add salt and noodles to actively boiling water and continue cooking until tender, about 20 minutes. Drain and rinse with cold water.
 2. Melt fat, add onions and parsley and simmer until onions are limp.
 3. Add beef and cook until browned.
 4. Add tomatoes, corn or peas, catsup, Worcestershire Sauce, salt, pepper and simmer for 5 minutes.
 5. Add to noodles and mix well.
 6. Pour mixture into greased casserole (1 $\frac{1}{2}$ qt. size).
 7. Spread on topping and bake in moderate oven 350°, 30 minutes.
- Serves 6.

HAM AND EGG CUSTARD

"Tastes good — is good. A small quantity of leftover ham can be used in this recipe."

- 4 slices whole wheat bread cut in strips; (leave crusts on)
- 1 c. grated cheese
- 4 eggs
- $\frac{3}{4}$ tsp. salt
- pepper
- 3 c. scalded milk
- $\frac{1}{2}$ c. finely minced leftover ham moistened with salad dressing or 3 oz. can devilled ham
- $\frac{1}{4}$ c. wheat germ

1. Arrange half the strips of bread in a well greased casserole (1 $\frac{1}{2}$ qt. size).
2. Sprinkle $\frac{1}{2}$ c. grated cheese over bread.
3. Arrange remaining bread over the top.
4. To slightly beaten eggs, add salt, pepper and scalded milk. Blend in ham.
5. Pour over bread and let stand 30 minutes.
6. Sprinkle top with remaining grated cheese and wheat germ.
7. Set in pan of warm water and bake in moderate oven 350°, 1 hour or until custard is done. Serves 6.



DO YOU KNOW

Do you know that dried beans and peas which are to be cooked in a pressure cooker do not require soaking overnight?

CHEESE FONDUE

"An old standby of the cooking class."

- 2 c. brown bread cut in $\frac{3}{4}$ " cubes
- 1 c. grated cheese
- 2 c. milk
- 2 tbsp. dripping, melted
- 1 tsp. salt
- 1 f.g. pepper
- 2 eggs

1. Grease a baking dish, place cubes of bread and cheese in layers, having bread on top.
2. Beat eggs, add milk, dripping and seasonings.
3. Pour mixture over bread. Allow to stand 20 minutes.
4. Place baking dish in a pan of hot water and bake in moderate oven 350°, 35 to 40 minutes.

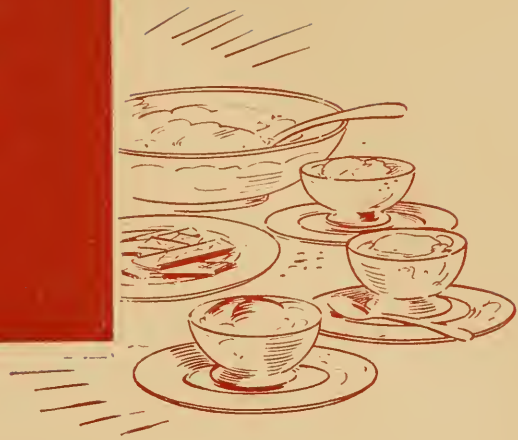
HANDY BREAD CROUSTADES

Attractive for use with stews and creamed mixtures.

1. Slice fresh bread as for toast.
 2. Remove crusts. Lightly brush one side with melted butter.
 3. Mould into muffin tins, pressing buttered side firmly into bottom edge of tin.
 4. Toast in moderate oven, 350°, 15-20 minutes or until golden brown.
- Rounds of bread (cut with round cookie cutter) may be used also.



DESSERTS



LEMON CREAM PUDDING

- 1½ c. scalded milk
- 3 tbsp. cornstarch
- 1 tbsp. flour
- ¾ c. sugar
- ⅛ tsp. salt
- ½ c. cold milk
- 2 lemons, grated rind and juice (6 tbsp. juice)
- 2 egg yolks, slightly beaten
- 2 egg whites, stiffly beaten

"The whole family will cheer this dessert!"

1. Mix cornstarch, flour, sugar and salt.
2. Slowly add cold milk and mix.
3. Add scalded milk and lemon rind to cornstarch mixture and cook over boiling water about 20 minutes, stirring constantly until mixture is thick.
4. Add some of the hot mixture to egg yolks. Stir into pudding and cook 5 minutes.
5. Remove from heat, add lemon juice.
6. Fold into beaten egg whites.
7. Chill. Serves 6-7.

ORANGE ALMOND PUDDING

- 1½ c. scalded milk
- 4 tbsp. flour
- ⅓ c. sugar
- ⅛ tsp. salt
- ½ c. cold milk
- grated rind of 1 orange
- 1 egg, beaten
- ½ tsp. almond flavouring

"The almond flavouring elevates this economical pudding."

1. Mix flour, sugar and salt.
 2. Slowly add cold milk and mix.
 3. Add scalded milk and orange rind and cook 20 minutes over boiling water, stirring till thickened.
 4. Combine some of hot mixture with egg. Stir into pudding. Cook 5 minutes.
 5. Partially cool. Add flavouring.
 6. Serve in pretty glass dessert dishes or sherbets:—
 - (a) plain.
 - (b) poured over fresh berries, orange sections or any fresh fruit which may be slightly sweetened.
 - (c) poured over drained canned fruit, peaches, pears, cherries.
- Serves 6.



CHOCOLATE CREAM BAKED WITH MERINGUE

"Serve this attractive pudding from its baking dish. It has eye appeal and lots of taste appeal too."

- 2¾ c. scalded milk
- 4 tbsp. cornstarch
- ¼ tsp. salt
- ⅓ c. sugar
- 4 tbsp. cocoa
- ¼ c. cold milk
- 2 egg yolks, beaten
- 1 tsp. vanilla

Meringue—

- 2 egg whites
- ½ tsp. salt
- 2 tbsp. sugar
- 2 tsp. cold water

1. Mix cornstarch, salt, sugar and cocoa to smooth paste with cold milk.
2. Add scalded milk and cook over boil-

ing water 20 minutes, stirring until thickened.

3. Add pudding mixture to egg yolks and vanilla. Mix.
4. Turn into lightly greased casserole, 1½ qt. size.
5. Make meringue by gradually adding sugar and water to partially beaten egg whites and salt. Beat until meringue will stand in peaks when beater is lifted from mixture. Spread meringue lightly on pudding.
6. Bake in moderate oven, 350°, 15 minutes.
7. Serve warm or chilled.

Serves 6-7.

LEMON CAKE PUDDING

"A quickly made pudding which is very popular."

- ⅔ c. sugar
- 2 tbsp. flour
- 1 c. milk, cold
- 2 egg yolks, beaten
- juice of 2 lemons (6 tbsp.)
- 2 egg whites, beaten

1. Mix sugar and flour.
2. Add milk, beaten egg yolks and lemon juice.
3. Fold into beaten egg whites.
4. Pour into greased casserole, 1½ qt. size. Place casserole in pan of hot water and bake in moderate oven, 350°, 1 hour.

Serves 4.

QUICK BREAD PUDDING (PRESSURE COOKER)

"In a hurry? Try this recipe for bread pudding."

- 2 c. scalded milk
- 3 - ½" slices fresh bread (cubed) or ⅔ c. fine dry crumbs
- 1 tbsp. butter
- 2 eggs, slightly beaten
- ½ c. brown sugar
- ½ tsp. cinnamon
- ¼ tsp. salt
- ½ tsp. vanilla
- ½ c. raisins (if desired)

1. Add bread and butter to milk, heated over boiling water.

2. Combine remaining ingredients.
3. Add milk mixture to egg mixture and turn into greased bowl which will fit in pressure cooker.
4. Tie several thicknesses of oiled brown paper over top of bowl.
5. Have 4 cups of hot water in cooker.
6. Place bowl on rack in cooker.
7. Allow steam to flow 5 minutes.
8. Cook at 15 lb. pressure 15 minutes.
9. Reduce pressure quickly to zero.

Serves 7.

PUMPKIN CUSTARD

"A Hallowe'en Special, enjoyed the year-round."

- 2 c. scalded milk
- 2 eggs, beaten
- 1 c. cooked pumpkin
- 4 tbsp. brown sugar
- 1 tbsp. cornstarch
- 1 tsp. cinnamon
- $\frac{1}{4}$ tsp. salt

1. To eggs, add pumpkin, sugar, cornstarch, cinnamon, salt and scalded milk.
 2. Pour into greased casserole, $1\frac{1}{2}$ qt. size, and set casserole in a pan of hot water.
 3. Bake in moderate oven, 350° , 1 hour, or until a knife inserted in middle of pudding comes out clean.
- Serves 6.

QUICK TAPIOCA PUDDING

- 3 tbsp. quick cooking tapioca
- $\frac{1}{3}$ c. brown sugar
- f.g. salt
- $2\frac{1}{4}$ c. cold milk
- 1 egg
- $\frac{1}{3}$ c. raisins
- $\frac{1}{2}$ tsp. vanilla

1. Mix tapioca, sugar and salt in top of double boiler.
 2. Add milk.
 3. Cook and stir over boiling water until creamy, about 12 minutes.
 4. Add a little pudding mixture to beaten egg, return to double boiler. Cook and stir 3 minutes longer.
 5. Add raisins and vanilla and chill.
 6. Serve with a topping of jam or jelly.
- Serves 5.

HALF HOUR PUDDING

- 1 c. sifted pastry flour
- 2 tsp. baking powder
- $\frac{1}{2}$ tsp. nutmeg
- f.g. salt
- $\frac{1}{2}$ c. wheat germ
- $\frac{2}{3}$ c. raisins
- $\frac{1}{2}$ c. milk
- 1 c. brown sugar
- 2 c. boiling water
- 2 tbsp. butter

1. Sift and mix flour, baking powder, nutmeg and salt.
 2. Stir in wheat germ, raisins and milk.
 3. Pour into deep buttered casserole, $1\frac{1}{2}$ qt. size.
 4. Mix brown sugar, boiling water and butter. Pour this mixture over the pudding.
 5. Bake in moderate oven, 350° , 30-40 minutes and serve hot.
- Serves 6.

BAKED RHUBARB

"Good for any Spring or Summer day."

- grated rind of 2 oranges
- 2 oranges, peeled and sliced
- $1\frac{1}{2}$ c. sugar
- 4 c. diced raw rhubarb

1. Place orange slices in lightly greased casserole.
 2. Add sugar and orange rind.
 3. Top with rhubarb.
 4. Bake covered at 350° , 40 minutes.
- Serves 5-6.

PLUM COBBLER

- 3 c. chopped canned plums
- $\frac{1}{4}$ tsp. cinnamon
- $\frac{1}{4}$ tsp. nutmeg
- 1 tbsp. fat

Biscuit mixture

- $\frac{3}{4}$ c. sifted pastry flour
- $\frac{3}{4}$ c. whole wheat flour
- 2 tsp. baking powder
- $\frac{1}{2}$ tsp. salt
- 4 tbsp. fat
- $\frac{1}{2}$ c. milk

1. Spread out plums in greased casserole, $1\frac{1}{2}$ qt. size.
 2. Sprinkle with spices and dot with fat.
 3. Sift and mix dry ingredients for biscuit mixture.
 4. Cut in fat.
 5. Add milk and stir until mixture leaves sides of bowl.
 6. Roll dough $\frac{1}{2}$ " thick and cut several slashes to allow steam to escape during baking.
 7. Place over fruit, to fit dish.
 8. Bake in hot oven, 400° , 40-45 minutes.
 9. Serve hot with dessert sauce. See following recipe.
- Serves 6-8.

DESSERT SAUCE

"Uses leftover syrup from preserved fruit."

- 1 tbsp. cornstarch or
- 2 tbsp. flour
- $\frac{1}{4}$ c. sugar
- f.g. salt
- rind of 1 lemon
- 1 c. syrup
- juice of $\frac{1}{2}$ lemon

1. Mix cornstarch, sugar, salt and lemon rind.
2. Slowly add syrup. Stir.
3. Cook and stir until sauce is thick.
4. Add lemon juice immediately before serving. Serve hot.

WHOLE WHEAT PASTRY

"More flavour and food value than ordinary pastry. You'll like it, too."

- 2 c. sifted pastry flour
- $1\frac{1}{2}$ c. sifted whole wheat flour
- $1\frac{1}{2}$ tsp. salt
- $\frac{3}{4}$ c. cold fat
- $\frac{1}{2}$ c. cold water (approximately)

1. Sift and mix flours and salt.
 2. Cut in fat until pieces are the size of large peas.
 3. Gradually add cold water and combine until dough clings together.
 4. Roll and bake in a very hot oven, 450° , 10-15 minutes or until brown.
- Makes 3 doz., 2" tart shells or 3, 9" pie shells or 1 double crust and 1, 9" shell.

BUTTERMILK OR SOUR CREAM FILLING FOR PIES AND TARTS

- 1 egg, slightly beaten
- $\frac{3}{4}$ c. brown sugar, well packed
- $\frac{1}{4}$ tsp. salt
- $\frac{1}{2}$ tsp. allspice
- 1 tsp. cinnamon
- $\frac{2}{3}$ c. thick sour milk or thick buttermilk
- 1 c. chopped raisins
- whole wheat pastry
- (see recipe above)

1. Gradually beat sugar, salt and spices into beaten egg.
 2. Add cream and raisins.
 3. Pour into pie plate or tart shells lined with pastry. Fill $\frac{1}{2}$ to $\frac{2}{3}$ full.
 4. Bake in a very hot oven, 450° , 10 minutes. Reduce heat and bake at 350° until filling is firm, 25-30 minutes.
- Makes 10 large tarts or 1 small pie.

LEMON CHEESE FILLING FOR TARTS

- 1 egg, beaten or 2 yolks
- $\frac{2}{3}$ c. sugar
- 3 tsp. grated lemon rind
- 3 tbsp. lemon juice
- $\frac{1}{2}$ tsp. salt
- $\frac{1}{2}$ c. dry cottage cheese (see below)
- whole wheat pastry (see page 52)

- 1. Beat sugar into beaten egg.
 - 2. Add rind, juice and salt. Stir.
 - 3. Sieve cheese into mixture. Stir well.
 - 4. Fill tart tins lined with pastry $\frac{1}{2}$ to $\frac{2}{3}$ full.
 - 5. Bake in a very hot oven, 450°, 10 minutes, then reduce temperature to 350° and bake 20-25 minutes.
- Makes 10 large tarts.

HOME-MADE COTTAGE CHEESE

"Use your own sour milk."

- 1. Use thick clotted sour milk. (We prefer partially skimmed milk for souring for this purpose).
- 2. Heat sour milk in pan over hot but not boiling water, about 10 minutes or until it separates into curds and whey.
- 3. Wring a double thickness of cheesecloth out of cold water and use as a bag to strain curds. Run a quart of cold water through curds. Hang bag in a cold place. The separation of curds from whey will take 1 to 2 hours.
- 4. Put cheese in bowl, mix well with salt and a little milk.
- 5. Chill.

APRICOT-PRUNE PIE

- whole wheat pastry (see page 52)
- 4 tsp. flour
- $2\frac{1}{4}$ c. cooked prunes, chopped
- $\frac{3}{4}$ c. cooked apricots, chopped
- $\frac{3}{4}$ c. sugar
- $1\frac{1}{2}$ tsp. lemon juice
- 2 tbsp. prune juice
- 2 tbsp. apricot juice
- $1\frac{1}{2}$ tbsp. butter (optional)

- 1. Line 9" pie plate with whole wheat pastry.
- 2. Sprinkle with flour.
- 3. Combine fruits and sugar and arrange in pie plate.
- 4. Pour combined juices over.
- 5. Dot with butter.
- 6. Cover pie with pastry.
- 7. Bake in hot oven, 425°, 35-40 minutes.



MUFFINS



SERVE muffins proudly, in place of cake. Muffins are less expensive and are quickly mixed. Try some new recipes. Variety is the spice of life and your daily meals!

WHEAT GERM MUFFINS

An excellent recipe from a famous Canadian restaurant.

- 1 $\frac{2}{3}$ c. sifted pastry flour
- 5 tsp. baking powder
- 1 tsp. salt
- 3 tbsp. sugar
- $\frac{2}{3}$ c. wheat germ
- 2 eggs
- 1 c. milk
- 7 tbsp. melted shortening

1. Grease 12 large muffin tins.
2. Sift flour, baking powder, salt and sugar into mixing bowl.
3. Stir in wheat germ.
4. Beat eggs well, add milk and melted shortening.
5. Add wet ingredients, all at one time to dry ingredients. Mix lightly and only sufficiently to dampen all flour.
6. Bake in a hot oven, 400°, 15-20 minutes.
7. Cool on rack.

GINGER CHEESE MUFFINS

Muffins with a tangy flavour. Delicious served with fruit.

- 1 c. sifted whole wheat flour
- 1 c. sifted pastry flour
- 1 tbsp. baking powder
- $\frac{1}{4}$ tsp. baking soda
- $\frac{1}{2}$ tsp. ginger
- $\frac{1}{2}$ tsp. salt
- 1 egg
- $\frac{1}{2}$ c. milk
- $\frac{1}{4}$ c. melted shortening
- $\frac{1}{2}$ c. corn syrup
- $\frac{2}{3}$ c. finely grated cheese (about 2 $\frac{1}{2}$ oz.); hard old cheese preferred

1. Grease 12 muffin tins.
2. Sift dry ingredients into mixing bowl.
3. To beaten egg, add milk, melted shortening, corn syrup and cheese.
4. Pour all mixed wet ingredients into centre of dry ingredients. Mix lightly and only sufficiently to dampen all flour.
5. Bake in moderate oven, 350°, 15-20 minutes.
6. Cool on rack.
Flavour improves on standing a few hours.

BERRY MUFFINS

A treat for the "good-old-summertime".

- 1 $\frac{1}{3}$ c. sifted whole wheat flour
- 1 $\frac{1}{3}$ c. sifted pastry flour
- 4 tsp. baking powder
- $\frac{1}{2}$ tsp. salt
- $\frac{1}{3}$ c. sugar
- 1 egg, beaten
- 1 c. milk
- $\frac{1}{4}$ c. melted shortening
- 1 c. berries

1. Grease 12 large muffin tins.
2. Sift measured dry ingredients into bowl.
3. Add milk and melted shortening to beaten egg.
4. Add all mixed wet ingredients to dry ingredients. Stir only enough to dampen flour.
5. Add berries. Combine with a minimum of stirring.
6. Bake in hot oven, 400°, 25 minutes.
7. Cool on rack.

BRAN MUFFINS

A year-round favourite. Serve them fresh from the oven with raw or stewed fruit.

- 2 c. sifted pastry flour
- 2 tsp. salt
- 1 $\frac{1}{2}$ tsp. soda
- 1 tsp. baking powder
- 4 tbsp. sugar
- 2 c. cooking bran
- 1 egg, beaten
- 2 c. sour milk
- $\frac{1}{3}$ c. molasses
- 2 tbsp. melted shortening
- 1 c. raisins (optional)

1. Grease 12 large muffin tins.
2. Sift flour, salt, soda, baking powder, sugar and combine with bran.
3. Combine beaten egg, sour milk, molasses, and melted shortening.
4. Add all mixed wet ingredients to flour mixture, stirring just enough to dampen flour.
5. Add raisins. Combine with a minimum of stirring.
6. Bake in hot oven, 425°, 25 minutes.
7. Cool on rack.

CORN BACON MUFFINS

You can serve these muffins without butter. The bacon fat rendered during baking makes muffins crisp and rich.

- 2 c. sifted pastry flour
- 4 tsp. baking powder
- 1 $\frac{1}{2}$ tsp. salt
- 6 tbsp. sugar
- 1 $\frac{1}{2}$ c. corn meal
- 2 eggs, beaten
- 1 $\frac{2}{3}$ c. milk
- 5 strips side bacon
(cut in quarters)

1. Grease 18 large muffin tins.
2. Sift flour, baking powder, salt and sugar into mixing bowl. Add corn meal and mix well.
3. Add milk to beaten egg.
4. Add all wet ingredients to dry ingredients and mix only enough to dampen all flour.
5. Place $\frac{1}{4}$ slice of bacon across top of each muffin before baking.
6. Bake in hot oven, 425°, 25 minutes. If necessary, use top element of electric stove for last few minutes of baking to ensure crisp bacon.

ORANGE MARMALADE MUFFINS

A family treat. Let these muffins substitute for cake.

- $\frac{1}{4}$ c. shortening
- $\frac{1}{3}$ c. sugar
- 2 eggs, beaten
- 1 c. sifted pastry flour
- 1 c. sifted whole wheat flour
- 4 tsp. baking powder
- 1 tsp. salt
- $\frac{2}{3}$ c. milk
- marmalade

1. Grease 12 muffin tins.
2. Cream shortening, add sugar and then beaten egg. Beat well.
3. Add sifted dry ingredients alternately with milk.
4. Fill tins $\frac{1}{3}$ full. Add 1 tsp. marmalade, then fill $\frac{2}{3}$ full.
5. Bake in hot oven, 400°, 20-25 minutes.
6. Cool on rack.

RAISIN SPICE MUFFINS

Substitute these muffins for cake any day.

- $1\frac{1}{2}$ c. sifted pastry flour
- $1\frac{1}{2}$ c. sifted whole wheat flour
- 4 tsp. baking powder
- 2 tsp. salt
- 3 tbsps. sugar
- 2 eggs, well beaten
- $1\frac{1}{4}$ c. milk
- $\frac{1}{2}$ c. shortening, melted
- $\frac{2}{3}$ c. raisins

TOPPING

- 2 tbsps. sugar
- $\frac{1}{4}$ tsp. cinnamon

1. Grease 18 muffin tins.
2. Sift dry ingredients into mixing bowl.
3. Add milk and melted shortening to beaten egg.
4. Add all wet ingredients to dry mixture and combine with minimum stirring until all flour is dampened, adding raisins during the last part of the mixing.
5. $\frac{2}{3}$ fill muffin tins and sprinkle each muffin with a little sugar and cinnamon topping.
6. Bake in hot oven, 425°, 15 minutes.

SPICED APPLE MUFFINS

Follow recipe for Raisin Spice Muffins (above).

Only change—

Substitute—1 c. chopped raw apple for $\frac{2}{3}$ c. raisins.

RAISIN ORANGE MUFFINS

Follow recipe for Raisin Spice Muffins (above).

Add—1 tbsps. grated orange rind at the time the raisins are added.
Omit—Sugar and cinnamon topping.

DO YOU KNOW

Do you know that overmixing is the most common cause of failure in muffins?

CAKES



“WHY have so many recipes for loaf cakes been included?” We anticipate your question after perusing the cake section. Several answers to your question follow.

Loaf cakes are often more quickly prepared than the traditional “butter” cake or variations. Frequently the muffin method of combining ingredients is used for loaves and creaming of shortening and sugar is not required. As a rule, it is unnecessary to ice loaf cakes. You save time and money by eliminating icings which supply chiefly carbohydrates or calories.

The loaf cakes included in this collection of recipes can be stored for a considerable period of time and are ready to serve at a moment’s notice. Consequently they have convenience value for a busy homemaker.

Loaf cakes lend themselves to the use of whole wheat flour, wheat germ, cooking bran and oatmeal. Let’s make cakes which contribute health value as well as flavour to our meals.

PRIZE CAKE *This recipe gives a large cake for the amounts of materials used. The proportion of ingredients and method of mixing make the difference.*

- | | |
|--|---|
| <ul style="list-style-type: none"> $\frac{1}{3}$ c. shortening 1 c. fine granulated sugar $\frac{1}{2}$ tsp. vanilla 2 eggs, well beaten $1\frac{3}{4}$ c. sifted pastry flour $2\frac{1}{2}$ tsp. baking powder $\frac{1}{4}$ tsp. salt $\frac{2}{3}$ c. milk | <ul style="list-style-type: none"> 2. Cream shortening well. Gradually add sugar. Beat well. Add vanilla and eggs. Beat. 3. Sift together the dry ingredients. 4. Add dry ingredients alternately with milk to shortening mixture. Stir very carefully when the mixing is nearing completion. 5. Bake in moderate oven, 350°-375°, 35 minutes. 6. Cool in pan 10 minutes. Take off paper immediately after removing cake from pan. Complete cooling on rack. |
|--|---|
- 1 Line with paper the bottom of 9" square pan.

ORANGE LOAF

This loaf has delicious flavour and makes use of the whole orange.

- 2 very small oranges
 - $\frac{2}{3}$ c. boiling water
 - 1 c. sifted whole wheat flour
 - $1\frac{1}{4}$ c. sifted pastry flour
 - $\frac{1}{2}$ tsp. salt
 - 2 tsp. baking powder
 - 1 tsp. baking soda
 - $\frac{1}{2}$ c. sugar
 - 1 c. chopped raisins (seeded preferred) or dates
 - 3 tbsp. melted shortening
1. Wash oranges. Extract juice. Remove seeds. Use $\frac{1}{3}$ c. juice.
 2. Grind orange skins finely in food chopper. Use $\frac{2}{3}$ c. ground rind, loosely packed.
 3. Pour water over rind. Let stand.
 4. Carefully grease loaf pan, 9" x 5" x 3".
 5. Sift and mix dry ingredients.
 6. Sift about $\frac{1}{4}$ c. mixed dry ingredients over fruit. Toss lightly.
 7. Add melted shortening and orange juice to rind and water. Mix. Pour into centre of dry ingredients. Mix only enough to dampen flour. Add floured fruit. Do not overmix.
 8. Bake in slow oven, 300°-325°, 1-1 $\frac{1}{4}$ hours.
 9. Leave in pan 10 minutes after removal from oven.
 - 10 After removal from pan, complete cooling on rack and store in tightly covered tin 12-24 hours before using.

BUTTERMILK LOAF

A loaf of good flavour, requiring neither eggs nor shortening.

- $2\frac{1}{4}$ c. sifted pastry flour
 - 3 tsp. baking powder
 - 1 tsp. soda
 - 1 tsp. salt
 - $\frac{1}{2}$ c. brown sugar
 - 3 c. cooking bran
 - 2 c. buttermilk
 - 1 tbsp. molasses
1. Carefully grease a loaf pan 9" x 5" x 3".
 2. Sift and mix flour, baking powder, soda, salt and sugar.
 3. Add bran.
 4. Add molasses to buttermilk.
 5. Pour wet ingredients into dry ingredients and mix until all flour is dampened.
 6. Bake in slow oven, 325°, 1-1 $\frac{1}{2}$ hours.
 7. Remove from pan and cool on rack.
 8. Store for 24 hours. This loaf will remain moist for several days and may be served with a thin spread of butter or cream cheese.

DATE LOAF

This recipe makes two loaves. The preparation time is short and the tasty loaves keep well. Serve plain, with a thin spread of butter or cream cheese.

- 2 c. chopped dates (about $\frac{3}{4}$ lb.)
 - 2 tsp. soda
 - 2 c. boiling water
 - 2 tbsp. shortening
 - $1\frac{1}{2}$ c. brown sugar
 - 2 eggs, beaten
 - $1\frac{3}{4}$ c. sifted pastry flour
 - $1\frac{3}{4}$ c. sifted whole wheat flour
 - 1 tsp. baking powder
 - $\frac{1}{4}$ tsp. salt
 - $\frac{1}{2}$ tsp. cinnamon
1. Sprinkle soda over dates. Add boiling water. Allow to cool.
 2. Carefully grease 2 loaf pans, 9" x 5" x 3".
 3. Cream shortening, sugar and eggs thoroughly.
 4. Add sifted dry ingredients alternately with date mixture.
 5. Bake in slow oven, 325°, 1 $\frac{1}{4}$ hours. Cake will shrink from sides of pan.
 6. Remove from pans and cool on rack.
 7. Wrap and store in tightly covered tin.

GUM DROP CAKE

Gum drop cake will keep for at least 3 weeks and is convenient to serve to unexpected guests on busy days when there is no time for baking. It is an economical substitute for fruit cake and a universal favourite. Gum drops especially prepared for use in baking may be cheaper than gum drop candies.

- 1 lb. gum drops (no black or purple)
 - 2¾ c. or 1 lb. seedless raisins
 - ½ c. shortening
 - 1 c. sugar
 - 2 eggs, beaten
 - 1 c. sifted pastry flour
 - 1 c. sifted whole wheat flour
 - ½ tsp. salt
 - 1 tsp. cinnamon
 - 1 tsp. nutmeg
 - 1 tsp. baking powder
 - 1 c. milk
1. Carefully grease loaf pan 9" x 5" x 3". Then line bottom and sides with double thickness of oiled wrapping paper.
 2. Cut gum drops quite finely with scissors. (2⅓ c. cut gum drops tightly packed).
 3. Mix gum drops and raisins.
 4. Thoroughly cream shortening, sugar and eggs. Beat well.
 5. Sift and mix dry ingredients.
 6. Sift about ⅓ c. dry ingredients over gum drops and raisins. Toss lightly.
 7. Add flour mixture, alternately with milk to creamed shortening, sugar and eggs.
 8. Add floured fruit.
 9. Bake in slow oven, 300°, 2½ hours.
 10. Cool slightly before removing from pan. Then carefully remove paper at once. Complete cooling on rack.
 11. Wrap. Store in tightly covered tin for several days before use. Cut as fruit cake.

WHEAT GERM CAKE

A fine textured cake with an interesting flavour.

- 1 c. milk
 - ½ c. wheat germ—loosely packed
 - ½ c. shortening
 - ⅔ c. sugar
 - 1 tsp. vanilla
 - 2 eggs, beaten
 - 2¼ c. sifted pastry flour
 - 4 tsp. baking powder
 - ½ tsp. salt
1. Line with paper the bottom of 9" square pan.
 2. Add wheat germ to milk. Allow to stand.
 3. Cream shortening. Gradually add sugar. Beat well. Add vanilla and eggs. Beat.
 4. Sift flour, baking powder and salt.
 5. Add dry ingredients alternately with milk and wheat germ to shortening mixture. Stir very carefully when mixing is nearing completion.
 6. Bake in moderate oven, 350°, 25-30 minutes.
 7. Cool in pan 10 minutes. Take off paper immediately after removing cake from pan. Complete cooling on rack.
 8. Cover with butterscotch frosting (below).

The flavour of this icing blends well with the flavour of the wheat germ cake.

BUTTERSCOTCH FROSTING

- 1 egg white
 - ⅛ tsp. salt
 - 2 tbs. cold water
 - 1 c. brown sugar, slightly packed
 - 1 tsp. vanilla or ¼ tsp. maple flavouring
1. Beat egg white in top of double boiler with good Dover egg beater.
 2. When whites begin to stiffen, sprinkle salt over surface and gradually add cold water and brown sugar which must be free from lumps.
 3. Place top of double boiler over gently boiling water and continue to beat until mixture will stand in peaks—about 7 minutes. Remove from heat.
 4. Cool slightly, add flavouring and spread on cake.

QUICK FRUIT LOAF

This fruit loaf is very quickly made and will keep for a week. It has a delicate refreshing flavour. Have you ever tried making your own peel?

- 1 egg, beaten
- $\frac{1}{2}$ c. fine granulated sugar
- $\frac{3}{4}$ c. milk
- 4 tbsp. melted shortening
- $\frac{1}{2}$ tsp. almond extract
- 1 tsp. lemon extract
- $\frac{1}{2}$ c. wheat germ
- $2\frac{1}{4}$ c. sifted pastry flour
- 1 tsp. salt
- 1 tbsp. baking powder
- 1 c. raisins
- $\frac{2}{3}$ c. mixed peel (about 4 oz.)
1. Beat egg with Dover egg beater. Add sugar, beat well.
2. Add milk, melted shortening, flavouring and wheat germ. Blend.
3. Grease loaf tin 9" x 5" x 3".
4. Sift dry ingredients together.
5. Sift about $\frac{1}{3}$ c. of mixed dry ingredients over fruit. Toss lightly.
6. Pour wet ingredients into dry ingredients. Stir slightly. Add fruit. Mix only enough to dampen all flour.
7. Bake in slow oven, 325°, 1 hour.
8. Remove from pan and cool on rack.
9. Wrap and store in tightly covered tin at least 24 hours before cutting.

TOMATO JUICE CAKE

An economical cake with a "tangy" flavour.

- 1 c. tomato juice
- 1 tsp. soda
- $\frac{1}{3}$ c. shortening
- $\frac{1}{3}$ c. sugar
- 1 egg, beaten
- 1 tsp. vanilla
- 2 c. sifted pastry flour
- $1\frac{1}{2}$ tsp. baking powder
- $\frac{1}{2}$ tsp. salt
- 1 tsp. nutmeg
- 1 tsp. cinnamon
- Optional additions*
- 1 c. raisins *or*
- $\frac{1}{2}$ c. raisins and $\frac{1}{2}$ c. dates *or*
- $\frac{1}{2}$ c. mixed peel and $\frac{1}{2}$ c. nuts
1. Line with paper the bottom of pan 8" x 8" x 2".
2. Mix soda with tomato juice and allow to stand.
3. Cream shortening. Gradually add sugar. Beat. Add beaten egg and vanilla.
4. Sift together dry ingredients. If fruit is to be added, sift about $\frac{1}{4}$ c. dry ingredients over fruit and toss lightly.
5. Add dry ingredients alternately with tomato juice to creamed shortening mixture. *Do not overmix.* Add flour-ed fruit last.
6. Bake in moderate oven, 350°, 35 minutes.
7. Remove from pan and cool on rack.
8. Serve with or without icing.

MOLASSES NUT BREAD

- 1 egg, beaten
- 1 c. milk
- 4 tbsp. melted shortening
- 4 tbsp. molasses
- 1 c. sifted whole wheat flour
- 2 c. sifted pastry flour
- 1 tbsp. baking powder
- $\frac{1}{4}$ tsp. soda
- $1\frac{1}{2}$ tsp. salt
- $\frac{1}{2}$ c. sugar
- 1 c. finely chopped walnuts (about 4 oz.)—optional
- If nuts are omitted*—Sift 1 tsp. cinnamon and $\frac{1}{2}$ tsp. nutmeg with dry ingredients.
1. Carefully grease loaf pan 9" x 5" x 3".
2. Beat egg. Add milk, melted shortening and molasses. Mix.
3. Sift and mix dry ingredients.
4. Lightly flour nuts with about $\frac{1}{4}$ c. dry ingredients.
5. Add wet ingredients to dry ingredients. Stir lightly. Add nuts and mix only until all flour is dampened.
6. Bake in slow oven, 325°, 1-1 $\frac{1}{4}$ hours.
7. Remove from pan and cool on rack.
8. Wrap. Store in tightly covered tin for a day before using.

COOKIES



TO-DAY, as in Grandmother's time, the well-filled cookie jar is a tradition in the Ontario home. We hope that the recipes in this book will be included among your favourites. You will find that these new cookies are more quickly made than many old-time recipes and that abundant use is made of inexpensive foods which are known to be good for your families — whole wheat flour, wheat germ, rolled oats and molasses. The cost of all recipes is moderate. Last, but not least, these cookies taste good — better than "store" cookies which may cost twice as much.

QUICK CHOCOLATE COOKIES

Notice the quick method and make certain before you begin that the shortening is at room temperature, soft but not melted.

- 1 c. sifted pastry flour
- 6 tbsp. cocoa
- $\frac{1}{2}$ tsp. soda
- $\frac{1}{2}$ tsp. salt
- 1 c. brown sugar
- $\frac{1}{2}$ c. shortening
(at room temperature)
- 1 egg, unbeaten
- 1 tsp. vanilla
- $\frac{1}{2}$ tsp. almond flavouring
(optional)
- 1 c. quick cooking oats
- $\frac{1}{2}$ c. wheat germ

1. Sift together flour, cocoa, soda, salt and sugar into bowl.
 2. Add shortening, egg and flavourings.
 3. Beat until smooth, about 2 minutes or 150 strokes. Dough is stiff.
 4. Add oats and wheat germ. Mix thoroughly.
 5. Test-bake one cookie.
 6. Drop tested mixture from teaspoon or roll in hand into ball and flatten with a fork on a greased cookie sheet.
 7. Bake in moderate oven 350° , 15 minutes.
 8. Cool on rack.
 9. Store in tightly covered tin.
- Yield $2\frac{1}{2}$ doz. cookies, 1" in diameter.

QUICK MIX VARIETY COOKIES

Notice the method and you will realize that you can make these cookies in a jiffy. Just be certain that your shortening is at room temperature. It is desirable to have eggs and milk at room temperature also. If you wish, divide the dough and make two varieties of cookies from this basic recipe.

- 1 c. sifted pastry flour
 - 1 tsp. baking powder
 - $\frac{1}{2}$ tsp. salt
 - 1 c. brown sugar
 - $\frac{3}{4}$ c. shortening (at room temperature)
 - 2 eggs, unbeaten
 - $\frac{1}{3}$ c. milk
 - 1 tsp. vanilla
 - 3 c. quick cooking oats
1. Sift together flour, baking powder, salt and sugar into bowl. Add shortening, eggs and half of milk to which vanilla was added.
 2. Beat until smooth (about 150 strokes or 2 minutes steady beating).
 3. Add remaining milk and rolled oats. Beat until combined.
 4. Test-bake one cookie. Add additional flour if mixture spreads too much.
 5. If desired, $\frac{1}{2}$ c. raisins may be added to $\frac{1}{2}$ of cookie dough and $\frac{1}{2}$ c. dates or $\frac{1}{2}$ c. chopped peanuts to the remainder.
 6. Drop tested mixture from spoon on greased pan.
 7. Bake in moderate oven, 350°, 15 minutes.
 8. Cool on cake rack.
 9. Store in tightly covered tin. Yield 4 doz. cookies, 1" in diameter.

MARMALADE DROP COOKIES

A favourite for those with "a sweet tooth".

- $1\frac{1}{2}$ c. sifted pastry flour
 - $1\frac{1}{2}$ c. sifted whole wheat flour
 - $\frac{1}{2}$ tsp. baking soda
 - $\frac{1}{2}$ tsp. salt
 - $\frac{1}{2}$ c. shortening
 - $\frac{3}{4}$ c. sugar
 - 2 eggs, well beaten
 - $\frac{3}{4}$ c. orange marmalade
1. Mix and sift flours, soda and salt.
 2. Cream shortening. Gradually add sugar and eggs. Beat well.
 3. Stir in flour, then marmalade.
 4. Test-bake one cookie. Add additional flour if required.
 5. Drop tested mixture from teaspoon on greased cookie sheets, 2" apart.
 6. Bake in moderate oven, 350°, 12 minutes.
 7. Remove from cookie sheets at once. Cool on rack.
 8. Store in tightly covered tin. Yield 4 doz. cookies, 2" in diameter.

OATMEAL JAMBOREES

Quickly made cookies which keep moist and improve in flavour during storage.

- $\frac{1}{2}$ c. sifted pastry flour
 - $\frac{1}{2}$ c. sifted whole wheat flour
 - 1 tsp. baking powder
 - $\frac{1}{2}$ tsp. salt
 - $1\frac{1}{2}$ c. quick cooking oats
 - $\frac{1}{2}$ c. seeded raisins
 - 1 egg, beaten
 - $\frac{1}{4}$ c. brown sugar
 - $\frac{1}{2}$ c. melted shortening
 - $\frac{1}{4}$ c. mild flavoured molasses
 - $\frac{1}{4}$ c. jam (raspberry or strawberry preferred)
1. Mix and sift flours, baking powder and salt.
 2. Stir in oatmeal and raisins.
 3. Beat sugar into egg, then shortening, molasses and jam and gradually stir in flour mixture.
 4. Test-bake one cookie. Add additional flour if required.
 5. Drop tested mixture from teaspoon on greased cookie sheets. Bake in moderate oven, 350°, 20 minutes.
 6. Cool on rack.
 7. Store in tightly covered tin. Yield, 2 doz. cookies, 2" in diameter.

CARROT COOKIES

Cookies with good flavour that keep well. If you use solidified honey, melt by placing honey in measuring cup in dish of hot water. Measure honey after melting.

- 1 c. sifted pastry flour
- 1 c. sifted whole wheat flour
- 2 tsp. baking powder
- $\frac{1}{4}$ tsp. baking soda
- 1 tsp. salt
- 1 tsp. cinnamon
- $\frac{1}{2}$ tsp. nutmeg
- 2 c. quick cooking oatmeal
- 1 c. raisins
- 1 c. chopped nuts (optional)
- $\frac{1}{2}$ c. shortening
- 1 c. very finely grated raw carrot
- 1 c. liquid honey or corn syrup
- 2 eggs, well beaten

1. Mix and sift flours, baking powder, soda and spices.
 2. Stir in oatmeal, raisins and nuts.
 3. Cream shortening, add carrots and honey or syrup. Beat well.
 4. Add eggs. Beat.
 5. Gradually add flour mixture.
 6. Test-bake one cookie. Add additional flour if mixture spreads too much on baking.
 7. Drop tested mixture from teaspoon on greased cookie sheet. Bake in slow oven, 325°, 20-30 minutes. These cookies burn quickly in a hotter oven.
 8. Cool on rack.
 9. Store in tightly covered tin.
- Yield 6 doz. cookies, 1" in diameter.

QUICK GINGER SNAPS

Easy-to-roll, quickly-made cookies which are crisp and flavourful.

- 1 c. shortening
- 1 c. brown sugar
- 1 c. molasses
- 2 tsp. ginger
- 1 tsp. soda
- $\frac{1}{2}$ tsp. salt
- $5\frac{1}{2}$ c. sifted pastry flour

1. Measure all ingredients except flour into a 4-quart sauce pan.
2. Heat and stir until mixture begins to boil.

3. Remove from heat and add flour, in four instalments. Beat well after each addition.
 4. Knead dough lightly for one minute on lightly floured board.
 5. Divide dough into four parts and roll very thin. This dough will roll easily and very little flour will be necessary to prevent sticking.
 6. Bake in slow oven, 325°, 12-15 minutes. These cookies burn easily.
 7. Cool on rack.
 8. Store in tightly covered tin.
- Yield 6 doz. cookies, 2½" in diameter.

JAM THIMBLES

Colourful additions to your cookie plate.

- $\frac{1}{2}$ c. mixed shortening and butter
- $\frac{1}{4}$ c. brown sugar
- 1 egg, slightly beaten
- $1\frac{1}{4}$ c. sifted pastry flour
- $\frac{1}{4}$ c. wheat germ
- red jam or jelly
- wheat germ for rolling

1. Cream fat and add sugar, beat well.
2. Add egg. Beat.
3. Add flour and $\frac{1}{4}$ c. wheat germ. Mix well.

4. Test-bake one cookie. Add additional flour if required.
 5. Roll tested dough in small balls between hands. Roll in wheat germ.
 6. Place on lightly greased cookie sheet. Press down centre with thimble. Bake in slow oven, 300°-325°, 5 minutes. Press down again. Bake 10-15 minutes longer.
 7. While still hot, fill centres with jelly or jam. Cool on rack.
 8. Store in tightly covered tin.
- Yield 20 cookies, 1½" in diameter.

SOUR MILK COOKIES

Another easy-to-roll cookie recipe with excellent flavour and a flaky texture resembling pastry. Keep dough in cold place. Roll and bake at your convenience.

- 4 c. sifted pastry flour
 - 1 tsp. soda
 - 1 tsp. baking powder
 - $\frac{1}{2}$ tsp. salt
 - 1 c. brown sugar
 - 1 c. wheat germ
 - $\frac{3}{4}$ c. lard
 - 2 eggs, beaten
 - $\frac{2}{3}$ c. sour milk or buttermilk
 - 1 tsp. nutmeg
 - 1 tsp. vanilla
1. Mix and sift flour, soda, baking powder, salt and sugar.
 2. Add wheat germ and mix.
 3. Cut lard into mixture very finely or use pastry blender. Work lightly and quickly.
 4. Combine eggs, milk, nutmeg and vanilla.
 5. Add to dry ingredients. Beat well to make a smooth dough.
 6. Cover tightly and chill till firm enough to handle — usually about 2 hours or the dough may chill overnight.
 7. Roll a small amount of dough at one time to $\frac{1}{4}$ inch thickness. Use lightly floured board.
 8. Place on lightly greased cookie sheet. Press two or three raisins or pieces of peel in centre of each cookie.
 9. Bake in hot oven, 400°, 10 minutes. These cookies burn quickly.
 10. Remove to cooling rack. Cookies crisp as they cool.
 11. Store when cold in tightly covered tin.
- Yield 4½ doz. cookies, 2½" in diameter.

ROLLED OATS REFRIGERATOR GOODIES

The dough can be kept for weeks in a cold place. Bake cookies as required.

- 1 c. lard
 - 2 c. brown sugar
 - 2 eggs
 - 1 tsp. vanilla
 - 1 c. ground raisins
 - 2¼ c. sifted pastry flour
 - 2 tsp. soda
 - 1 tsp. salt
 - 2 c. rolled oats
 - $\frac{1}{2}$ c. chopped nuts (optional)
1. Cream lard and brown sugar until fluffy.
 2. Add eggs one at a time, beating well after each addition.
 3. Add flavouring and raisins.
 4. Sift flour, soda and salt together. Add dry ingredients, rolled oats and nuts, blending well.
 5. Shape into rolls about 2" in diameter wrapping each roll in waxed paper.
 6. Chill thoroughly, then slice into $\frac{1}{4}$ " thick slices.
 7. Bake on ungreased cookie sheets in moderate oven, 350°, about 15-20 minutes.
 8. Remove to cooling rack. Cookies crisp as they cool.
- Yield 5-6 dozen cookies.



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ABBREVIATIONS

cup.....	c.
tablespoon.....	tbsp.
teaspoon.....	tsp.
few grains.....	f.g.

EQUIVALENTS

1 c.	8 oz.
16 tbsp.	1 c.
3 tsp.	1 tbsp.

RURAL SEWAGE DISPOSAL

*Small Septic Tank System
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By

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and

T. R. C. Rokeby, Graduate Scholarship

The Canadian Institute of Plumbing and Heating

DEPARTMENT OF AGRICULTURAL ENGINEERING

ONTARIO AGRICULTURAL COLLEGE

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ONTARIO

DEPARTMENT OF HEALTH

FOREWORD

There is great need for information on sewerage systems for homes and other premises not accessible to public sewers. The rapid extension of building to rural and semi-rural areas has focused attention on these methods of sewage disposal.

This publication is an effort to supply that information. It gives comprehensive data on the different methods which can be utilized. Local conditions will affect the choice of method. Most emphasis in this pamphlet is placed on the water-carried system as a modern method of disposal of these wastes. Where drainage conditions are suitable, the septic tank system can be expected to function effectively, if it is properly installed and given reasonable maintenance.

A handwritten signature in cursive script, reading 'A. E. Berry'.

Director, Sanitary Engineering Division,
Ontario Department of Health.

RURAL SEWAGE DISPOSAL

SEWAGE DISPOSAL AND HEALTH

The safe disposal of human and domestic wastes is of vital importance from the standpoint of protecting the health of the individual family and the community, as well as preventing unsightly conditions and foul odours. Epidemics of typhoid fever, dysentery, and diarrhea have been traced to fecal contamination of water supplies and food. Individual water supplies may be contaminated by the seepage of sewage through porous earth or the entrance of polluted surface water through open well cribbing and inadequate covers. Flies, other insects, and rodents having access to feces may contaminate human food and are potential disease carriers. It is essential that these hazards be eliminated by the satisfactory disposal of household wastes.

THE PUBLIC HEALTH ACT

As a precaution against the spread of sewage-borne diseases the Public Health Act of Ontario contains the following, concerning the disposal of sewage:

Section 98, Paragraph 1. — “No garbage, excreta, manure, vegetable or animal matter or filth should be discharged into or deposited in any of the lakes, streams, or other waters in Ontario or on the banks and shores thereof . . .”

Section 124, paragraph 14. — “No privy vault, cesspool, septic tank or reservoir into which a privy, water-closet, stable, or sink is drained shall be established until the approval in writing of the Medical Officer of Health has been obtained.”

It is important that these regulations be strictly followed and that the necessary permits be obtained before the construction of any sewage disposal system is undertaken.

SEWAGE DISPOSAL SYSTEMS

This bulletin treats rural sewage disposal under two main headings:

- (1) Water-carriage methods, for those homes with running water available.
- (2) Non-water-carriage methods, for those without running water.

SEWAGE DISPOSAL WITH WATER CARRIAGE

A water carriage system consists of the fixtures and piping which receive all sewage at the point of origin and carry it to the place of disposal by the flow of water. This is the best method of disposal, but it is only possible where running water is available. Where there are no public sewers the most satisfactory method of disposal with water carriage is by a septic tank and subsurface disposal field.

THE SEPTIC TANK SYSTEM

The essential parts of a septic tank system, as shown in Fig. 1 are:

- (1) The house plumbing
- (2) The house sewer
- (3) The septic tank
- (4) The effluent sewer and disposal field or other means of final disposal.

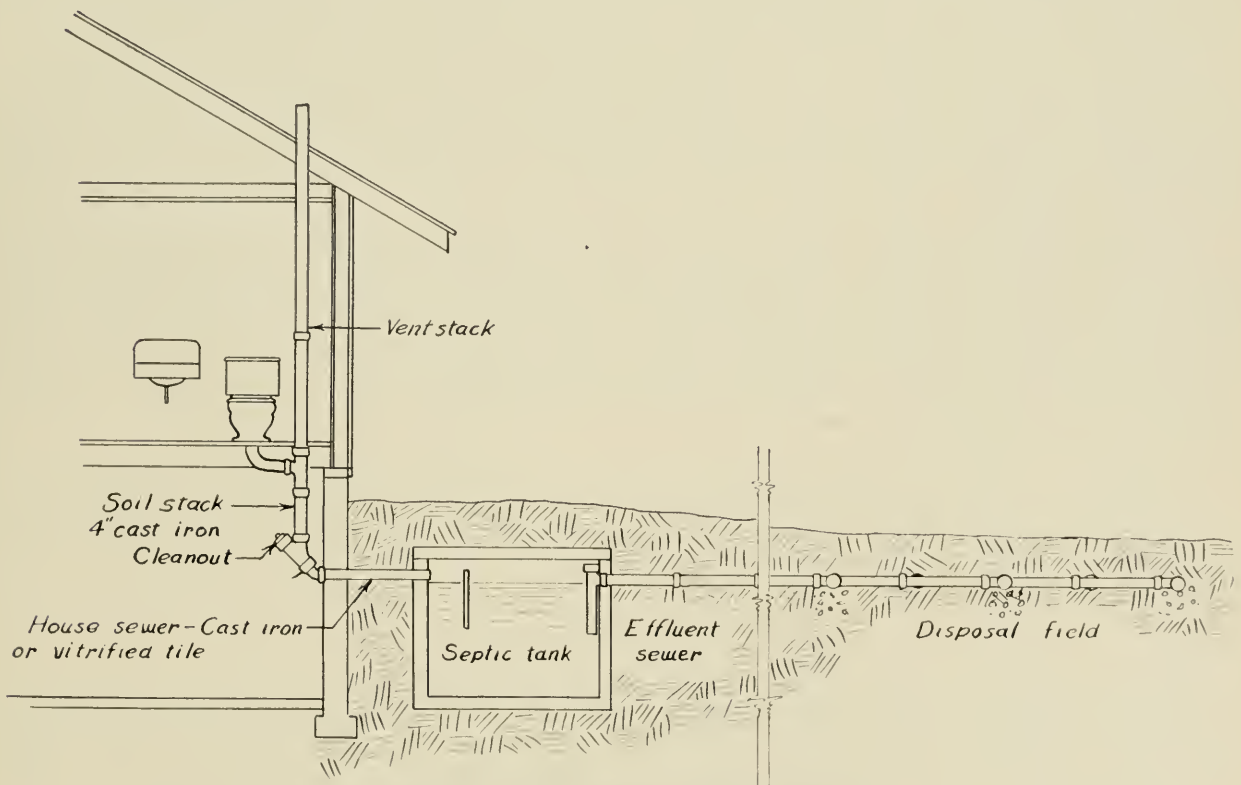


Figure 1—The Septic Tank System.

THEORY OF A SEPTIC TANK SYSTEM

The sewage is carried by the flow of water from the fixtures in the house through the plumbing and house sewer into the septic tank. Here it should remain 24 hours, to allow the heavier solids to settle to the

bottom and the lighter to float to the top. Anaerobic bacteria, which work only in absence of oxygen, act upon the organic matter of the solids, converting most of it to liquids and gases. The gases escape through the venting system, and the liquids are carried off in the effluent, leaving the coarser, inert solids in the bottom of the tank as a sludge. During the decomposition gas bubbles adhere to some of the heavier solids, buoying them up. These, with the light solids and fats, form a thick scum floating on the surface of the liquid. Sludge and scum accumulations increase until it becomes necessary to clean out the tank because of the reduced liquid capacity of the tank and the danger of sludge being carried over in the effluent and clogging the tile.

Contrary to general belief, the septic tank does not “purify” sewage. Septic tank effluent may be as dangerous to health as raw sewage, and equally unpleasant. The usual method of purification is by bacterial action in the upper layers of soil. The effluent is usually distributed through the upper soil by a tile disposal system. This allows it to seep gradually into the soil near the surface, where excess water can drain away and organic materials be broken down thoroughly by soil bacteria.

LOCATION OF SEPTIC TANK AND DISPOSAL TILE

The disposal field must be on well-drained land; away from trees; at least 100 ft. from the nearest well; and, if possible, on a lower elevation. A lawn, meadow, or cultivated field is suitable. The septic tank should be located so that **the house sewer runs in a straight line** to it from the foot of the soil stack, and so that the effluent main to the disposal bed also is straight. It should be 50 ft. or more from the well and preferably on a lower elevation. Placing the tank on the south side of the house is preferable, as it gives added protection against freezing, but ease of connection to the house plumbing should be considered.

It is preferable to build the tank several feet from the basement walls, in case a leak develops. However the tank, if carefully constructed and maintained, may be placed against the wall, but the basement wall must not be used as one wall of the tank. Because the tank must be easily accessible for cleaning, do not place it under driveways, pavements, flower beds or shrubbery.

Where a siphon type of tank is used it may be necessary to build the tank partly above ground so that the disposal tile can be kept within two feet of the surface. A terrace or mound can be built over the tank when completed.

SOIL AND WASTE PLUMBING

It is strongly recommended that no one without the necessary qualifications and equipment undertakes the plumbing installation. However the house owner, if possible, should assist the plumber, thus gaining a knowledge of the system which will be useful if repairs become necessary.

Figure 2 shows a typical waste and soil pipe layout for a two-storey house with bathroom on the second storey and a kitchen sink on the first. This drawing is included merely to illustrate the basic principles and fixtures involved, and is not intended as a plan to be followed for installations.

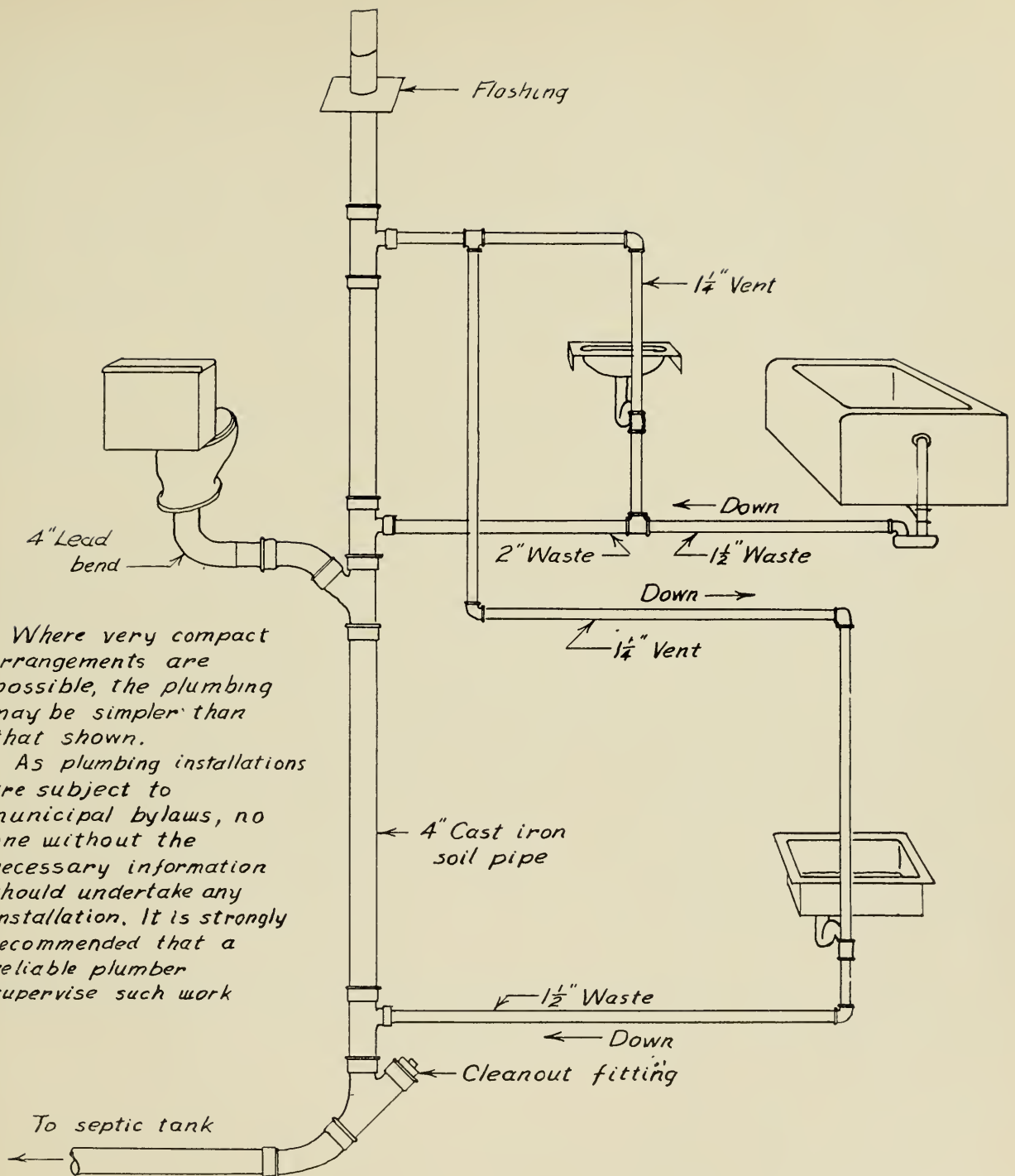


Figure 2—Waste and Soil Plumbing.

THE HOUSE SEWER

The house sewer must be constructed of impervious material, with tight joints, to prevent leakage which might enter the cellar. Four-inch cast iron soil pipe, with lead-caulked joints, is commonly used. Where the tank is some distance from the house vitrified clay tile with cemented joints, preferably the six-inch size, may be used, but the cast iron must be used within three feet of the basement wall, under roadways, and near trees. The house sewer should run in a straight line, with a fall of not less than $\frac{1}{4}$ inch per foot. Where grades of 2 in. per foot or greater are required the two sections of pipe nearest the tank should be laid at $\frac{1}{4}$ in. per foot to reduce the velocity of flow.

TYPES OF SEPTIC TANK

Several types of septic tanks are in use, the more common being the single chamber tank, and the double chamber tank with siphon discharge. For individual installations serving up to 8 or 10 people the single chamber tank is adequate, and more economical to build than the double chamber type. The double chamber tank with siphon is recommended for larger installations. The single chamber tank may be constructed of concrete or may be bought prefabricated. The prefabricated tanks available commercially are of steel, concrete, or vitrified clay. No tank of under 400 Imperial gallons capacity should be installed. A tank which is too small may allow passage of solids out with the effluent, and fill up rapidly with sludge, thereby plugging the disposal field.

Steel tanks should be 12 gauge or heavier copper-bearing steel, coated inside and out with a durable corrosion-resistant coating. If this coating is damaged in any way it should be repaired before the tank is installed.

CONSTRUCTION OF THE SINGLE CHAMBER CONCRETE SEPTIC TANK

A septic tank of concrete constructed on the site is usually cheapest, and if properly built will last indefinitely. Septic tank forms have been designed by the Department of Agricultural Engineering, Ontario Agricultural College, and are available on loan, free of charge, from the Agricultural Representative of each county or district, and from the Department of Agricultural Engineering, Ontario Agricultural College, Guelph. These forms, which are easily portable, fit in the trunk of a car. These are interior forms for building a cast-in place tank, five feet long, four feet wide, and five feet deep. The earth walls of the excavation are used as the outer form. This gives a total liquid capacity of over 500 Imperial gallons, sufficient for households of up to 8 people. For larger households the length of the tank may be increased by adding temporary side panels to the forms.

Before commencing any construction work first re-read carefully the section on locating the septic tank and determine the proper location for the tank. Then obtain all materials and equipment.

Materials and Equipment

- 1 set of portable forms, obtainable from your Ag. Representative
- 19 bags Portland Cement
- 1½ cu. yds. clean, sharp sand
- 2¼ cu. yds. of gravel or crushed stone (not over 1½ in. diameter)
- 90 ft. steel reinforcing rod or heavy wire
- 1 4-in. cast iron soil pipe or vitrified tile tee 24 in. long for outlet.
- 4-in. cast iron or vitrified tile for house sewer.

Arrangements should also be made for the use of a cement mixer. As the soil surrounding the excavation is used as the outer form, it is necessary to be ready to pour concrete as soon as possible after completing the excavation, to guard against trouble from caving of the walls. The forms for the cover slabs should be made and placed in a shady place out of the way, so that they will not have to be moved after the concrete is poured.

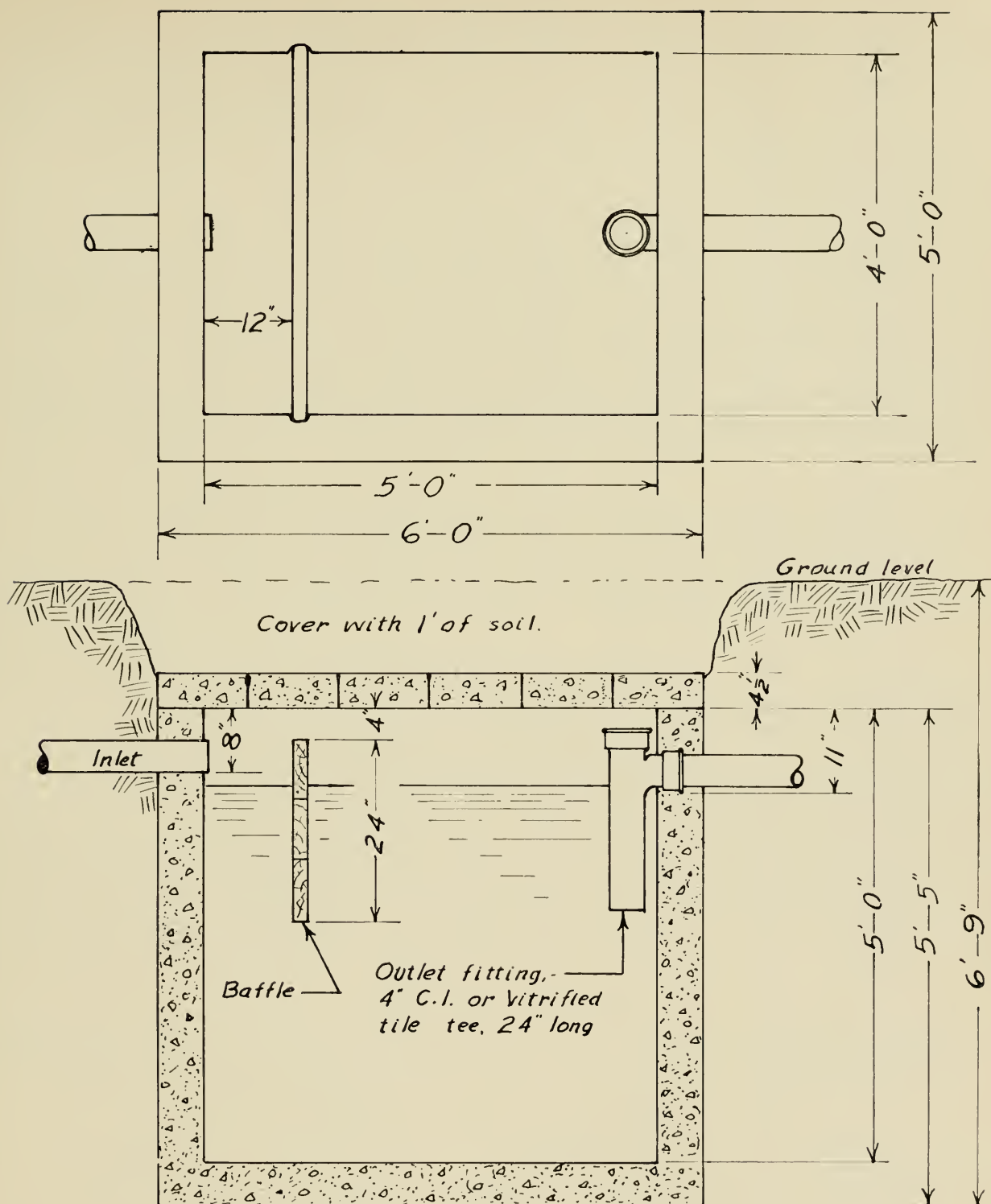


Figure 3—The Single Chambered Concrete Septic Tank.

Staking and Excavating

The outline of the hole should be staked out carefully, using a carpenter's square to line up the corners. The hole should be made **exactly 6 feet long and 5 feet wide and about 6 feet 9 inches deep**. When digging care should be taken to keep the sides perfectly smooth and plumb, using a plumb bob or carpenter's plumb-and-level. The bottom should be smoothed and levelled. Planks laid around the top of the excavation will prevent breaking the edges of the hole.

If the tank is to be built against the cellar wall a hole for the house sewer must be broken through the wall at this time. The hole should be about eight inches in diameter, centred about six inches below the estimated top of the tank. A layer of tar paper must be placed against the wall to prevent the tank wall from adhering to the basement wall, with possible resulting breakage.

Placing the Form

Oil or grease the outside of the form to prevent concrete from adhering to it. Place the sections of the form in the hole, with top ends up. The two sections with the mold for the baffle slots are placed at the inlet end. Hook the forms together and block them up about six inches from the bottom of the hole, with stones under each corner, or suspend them from planks laid over the hole as shown in Fig. 4. Adjust the position of the form so that it is an equal distance from the sides of the hole, and level it. Stakes may be driven in each corner inside the form to prevent it from shifting.

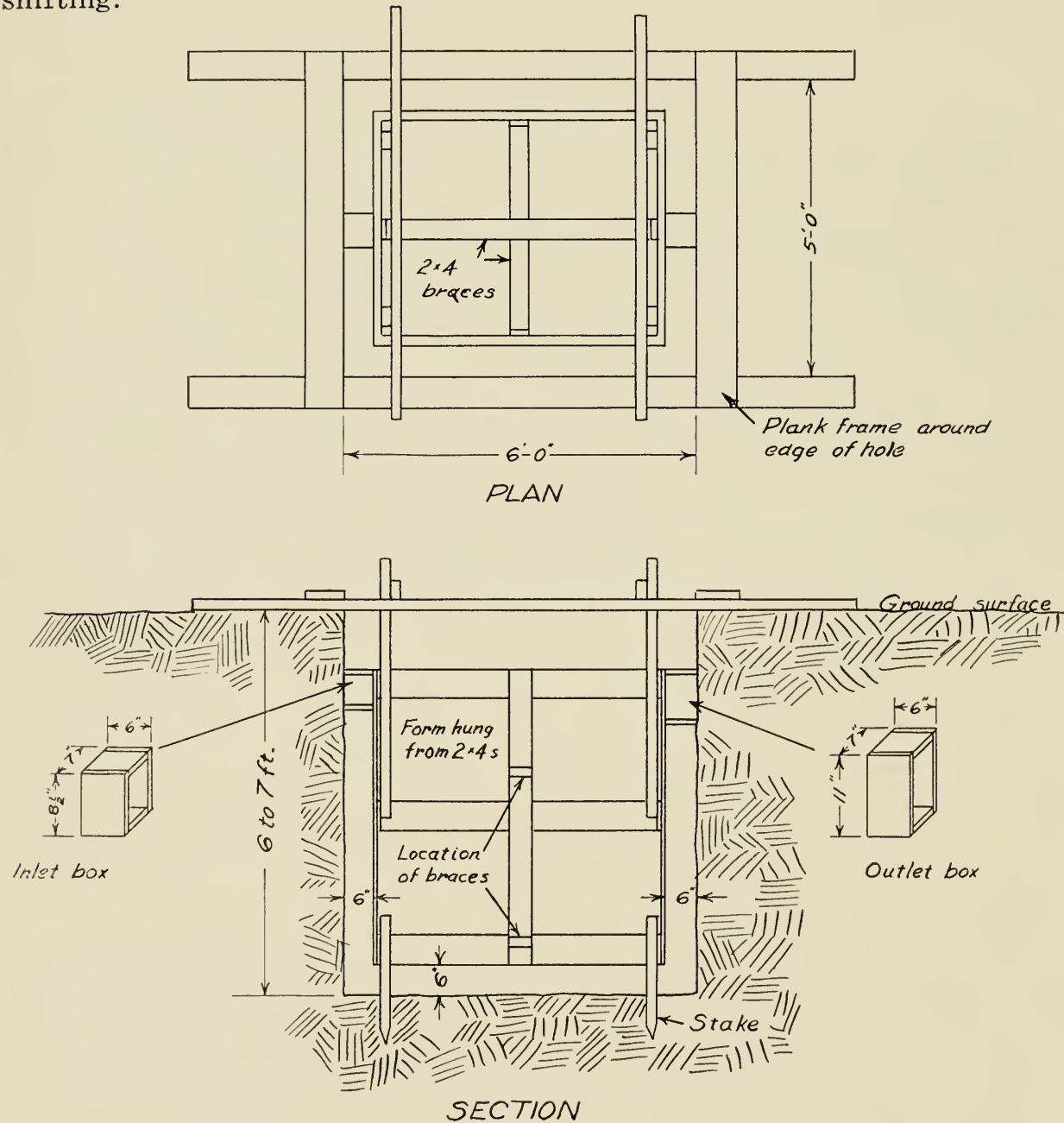


Figure 4—The Form in Place.

The four wooden braces are placed in the form, as shown in Fig. 4. These 2 x 4 braces must be supplied by the farmer himself and should be two pieces, 4 feet 7 inches long, and two pieces, 3 feet 7 inches long.

Concrete Mixing and Pouring

The recommended mixture of concrete is 1:2:3 (1 sack of cement, 2 cu. ft. of sand, and 3 cu. ft. of gravel or crushed stone) with no particles larger than $1\frac{1}{2}$ in. If pit-run gravel is used, a mixture of 1 sack of cement to 5 cu. ft. of good clean pit-run gravel is satisfactory. Not over four gallons of water should be used for each sack of cement, if the sand and gravel are normally damp. A fairly stiff mix makes better concrete than a sloppy mix.

The concrete should be poured evenly all around the form and spaded next to the form as it is added. As the top of the wall is approached wooden boxes, as shown in Fig. 4, should be placed to allow for the later installation of the inlet and outlet fittings. The wall, when completed, should be smoothed off level with the top of the form.

Putting in the Bottom

When the walls have been completed the stakes at the corners of the form should be removed and the bottom poured. It should be about 5 inches thick and trowelled smooth, care being taken that it does not extend above the lower edges of the form, and thereby make removal of the forms difficult.

Cover Slabs

A sectional top made of slabs is easier to build and more convenient than a solid top with manholes. Forms may be made for the cover slabs as shown in Fig. 5. Six slabs will be needed, 5 feet long, 12 inches wide, and $4\frac{1}{2}$ inches thick. Three $\frac{1}{4}$ inch reinforcing rods placed lengthwise in each slab, $\frac{3}{4}$ in. from the bottom will be required. Iron rings or old horse-shoes may be set in the top to serve as handles. After being poured the slabs should be kept shaded and moist for at least a week before removing from the form. When they have cured for a week the cover slabs may be put in place on the tank, and a foot of earth placed over them to protect the tank from frost and to prevent the escape of odours.

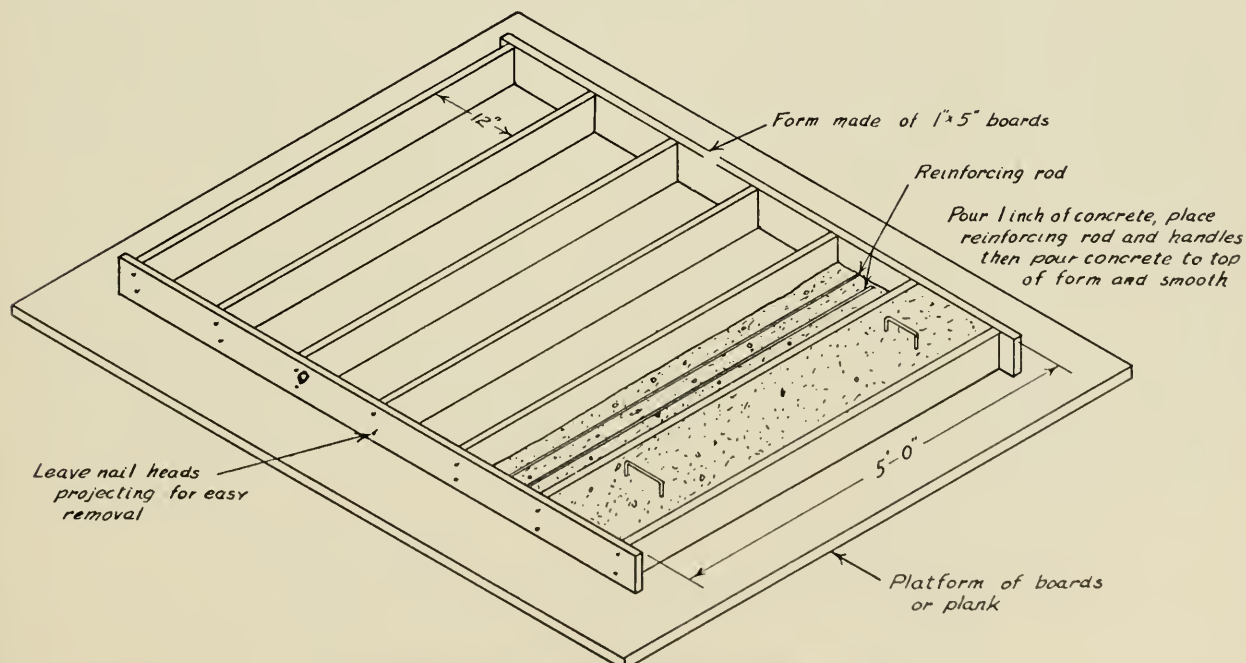


Figure 5—Forms for the Cover Slabs.

Installing Inlet and Outlet

When the concrete has set for two days the forms should be removed, thoroughly cleaned and returned. The wooden sleeves are also **taken** out, care being taken not to crack the concrete. Now the inlet and outlet fittings may be set in place. The first outlet tile is calked into the hub of the outlet tee and this hub should be placed in the outlet opening in the tank wall. Fill the spaces around the fittings with concrete, and smooth off level with the top of the wall.

When this has set the inside of the wall should be moistened and painted with a creamy mixture of cement and water, which must be kept damp until it has set.

Installing the Baffle

The baffle is formed of 4 ft. 2 in. lengths of 2 in. plank, slipped into the slots left in the walls near the inlet end. The ends of these planks should be rounded slightly so they are a loose fit in the slots. Leave 4 in. space between the top of the baffle and the top of the tank.

THE DISPOSAL FIELD

A disposal field is an open-jointed system of tile by which the septic tank effluent is distributed into the upper layers of the soil. In impervious soil other methods may be required, but where the soil is suitable the sub-surface disposal field is the best and safest method.

The disposal field must be designed to give uniform distribution of the effluent throughout. This requires careful attention to levels and grades, and special methods where the field must be on sloping land. The main line of tile connecting the septic tank to the various branches of the disposal field should be of vitrified tile with cemented joints, although field tile may be used where the well is a good distance away and there are no trees nearby.

Four-inch field tile is generally used for the branches, although perforated fibre tile is available for this purpose. The tile should be laid 15 to 24 inches below the surface, with the joints open $\frac{1}{4}$ inch. Except in very well-drained soil the trench should be dug 6 or more inches deeper than the tiles are to be laid, and a layer of coarse gravel placed in the bottom of the trench with the tile laid on this gravel. The top half of the joints are covered with strips of tar paper, metal, or broken tile, then the trench backfilled with earth. Individual tile lines should be laid on a slope of from 1 to 3 inches in 50 feet, spaced at least 4 feet apart, and should not be over 30 feet in length. The amount of tile required for each person contributing may be determined by a simple percolation test.

Percolation Test

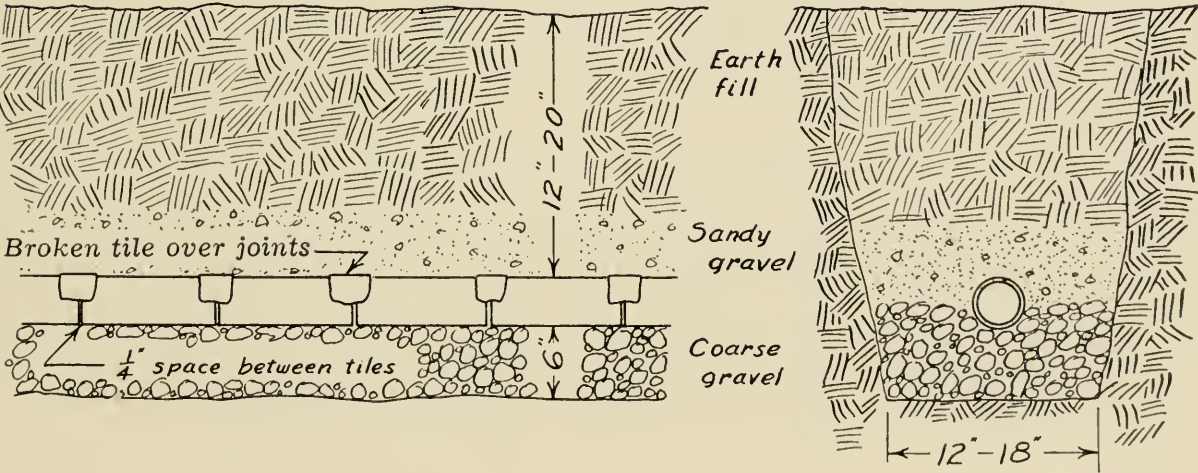
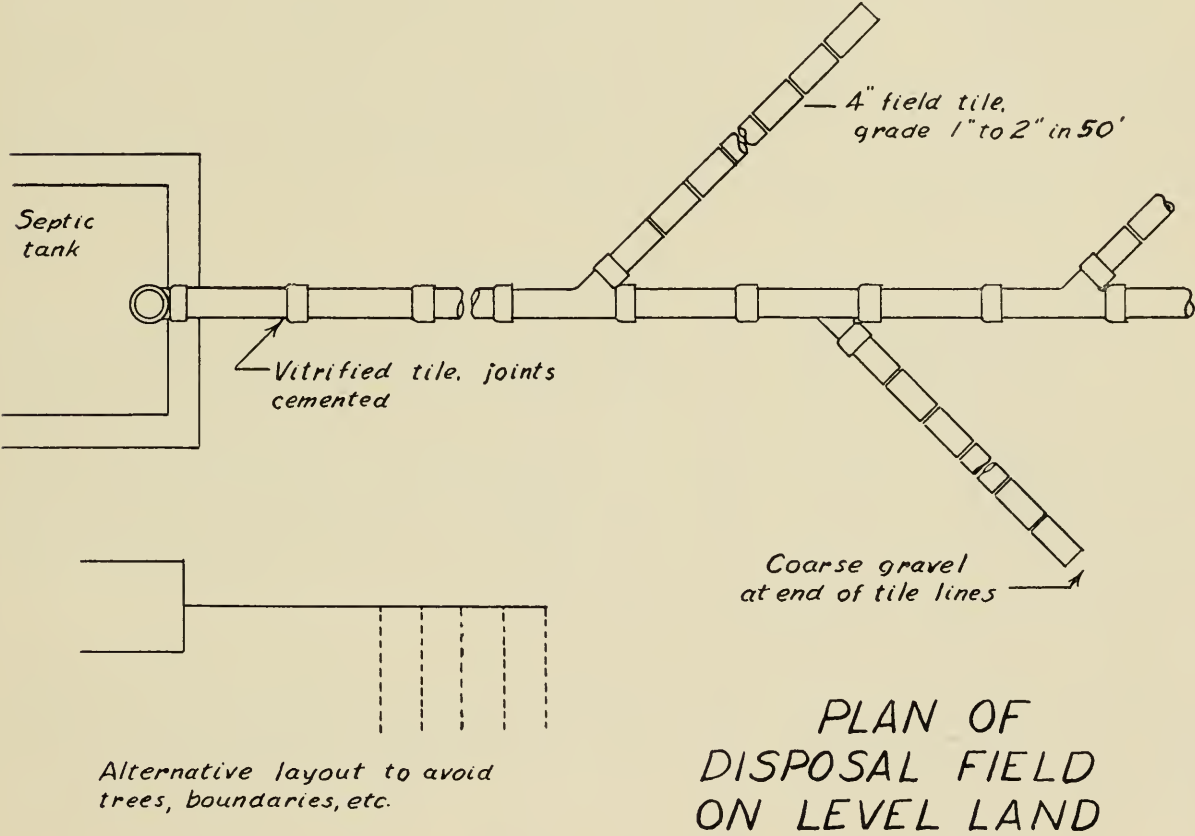
Dig a hole about 1 foot square, 18 to 24 inches deep (the depth at which the tile is to be laid). Fill the hole with water and allow it to seep away. While the bottom of the hole is still moist, refill the hole with water to a depth of 6 inches and observe the time required for the water to fall 1 inch. The number of feet of tile required per person is shown in the following table, however, no system should be built using less than 150 feet.

TABLE I

Time in minutes for water to fall one inch	No. of feet of 4" tile required per person
0 - 5	25
6 - 8	30
9 - 11	35
12 - 15	40
16 - 20	45
21 - 30	55

This test will be of value only if made under conditions of normal soil moisture. If the soil is unusually wet the time for the water to fall will be greater, and if unusually dry the time will be less than under normal conditions.

If the water does not fall one inch in thirty minutes the ground is not porous enough for a disposal field, and filter trenches or a seepage pit will be required.



DETAILS OF DISPOSAL TRENCH

Figure 6—Disposal Field for Level Land.

Layout on Level Land

The disposal field may be laid out as shown in Fig. 6. Any of these methods may be modified to suit the available space. Where tees or wyes are used to connect the branches to the main they should be placed with the side outlets perfectly level to ensure that all branches receive an equal amount of effluent. Never use a single line of tile in any installation.

Layout on Sloping Land

On sloping land the disposal field must be designed to prevent all the effluent running to the lower line of tile and overloading it. The method shown in Fig. 7A, using a distribution box to equalize flow, is recommended. The outlets from the distribution box must all be on the same level, and the first tile out of the box laid perfectly level. The lines of disposal tile need not be straight, but should follow the contour of the land to maintain proper grade and depth.

THE FILTER TRENCH

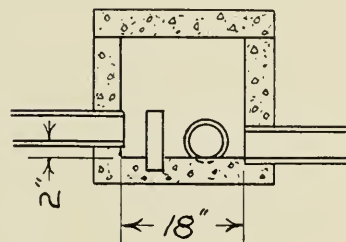
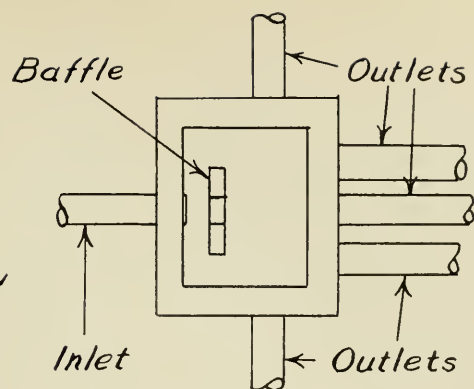
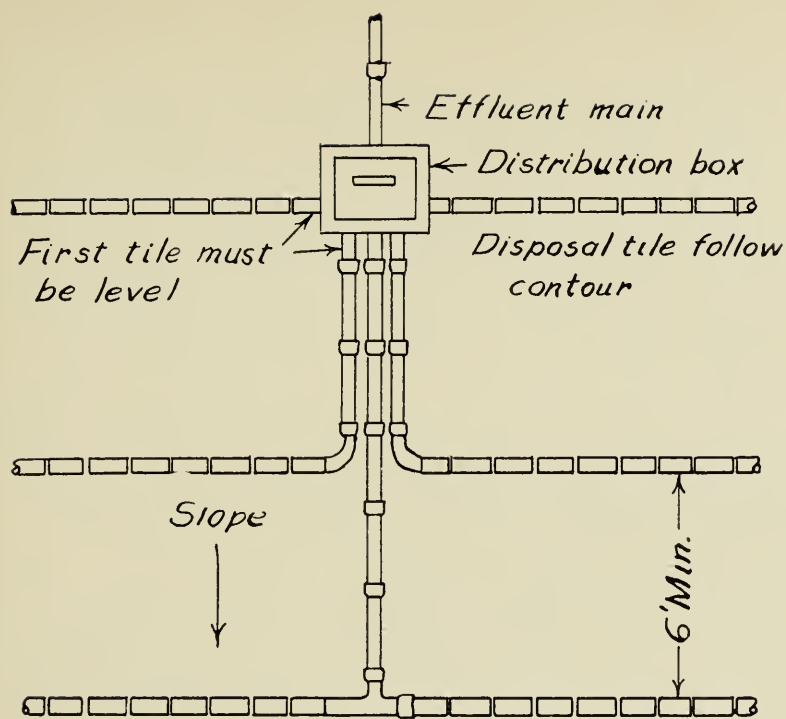
Where very impervious soil makes the operation of a disposal field impracticable, a filter trench which permits excess water to be drained from the effluent may be used, as shown in Fig. 8. Trenches about 4 feet deep and 2 feet wide are dug and a line of drain tile connected to a field drain, a seepage pit, or a surface outlet, laid in the bottom. A two-foot layer of pit-run gravel or coarse sand is placed in the trench and then a line of disposal tile connected to the septic tank outlet laid on top. The tile is covered with a six-inch layer of gravel and the trench backfilled with soil. 8 to 10 feet of trench per person is required.

In some cases, absorption difficulties are encountered which are due to a high water table in the area, rather than impervious soil. Such difficulties may be remedied by installing underdrains between the lines of disposal tile and connecting them to the field drainage system or a surface outlet.

SEEPAGE PITS

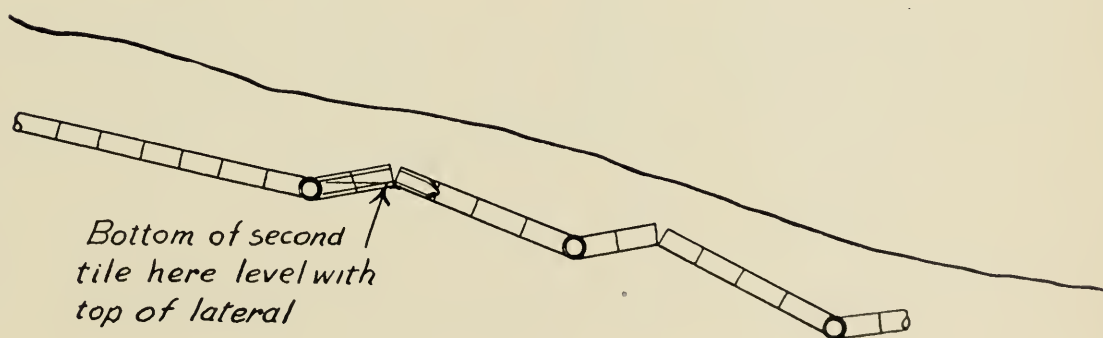
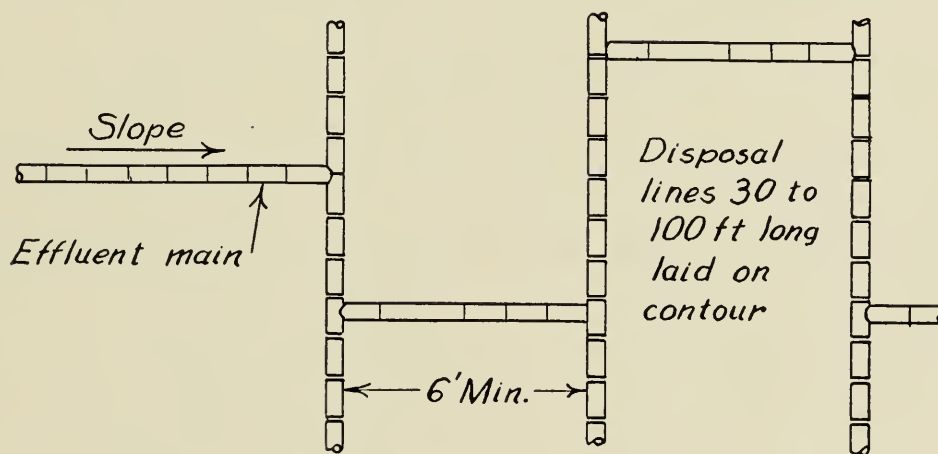
A seepage pit, as shown in Fig. 8, may be used where there are no shallow wells nearby and space is insufficient for a sub-surface disposal field. It consists of a pit dug down to a porous soil layer, cribbed with stone, cement block or logs laid with open joints to allow the liquid to seep out into the soil.

It may be used for disposal of septic tank effluent, effluent from filter trenches or roof drains. The depth of the seepage pit depends on the location of suitable soil strata but should not approach the soil water table. A pit 6 feet in diameter and 5 feet deep below the inlet should dispose of effluent from a septic tank serving 6 to 8 persons. The pit should have a strong cover which may be of plank or logs, but preferably of concrete with a manhole. The pit should be covered with a foot or more of earth.



DISPOSAL FIELD FOR SLOPING LAND

DISTRIBUTION BOX



SLOPING DISPOSAL FIELD FOR SYPHON TANK

Figure 7—Disposal Fields for Sloping Land.

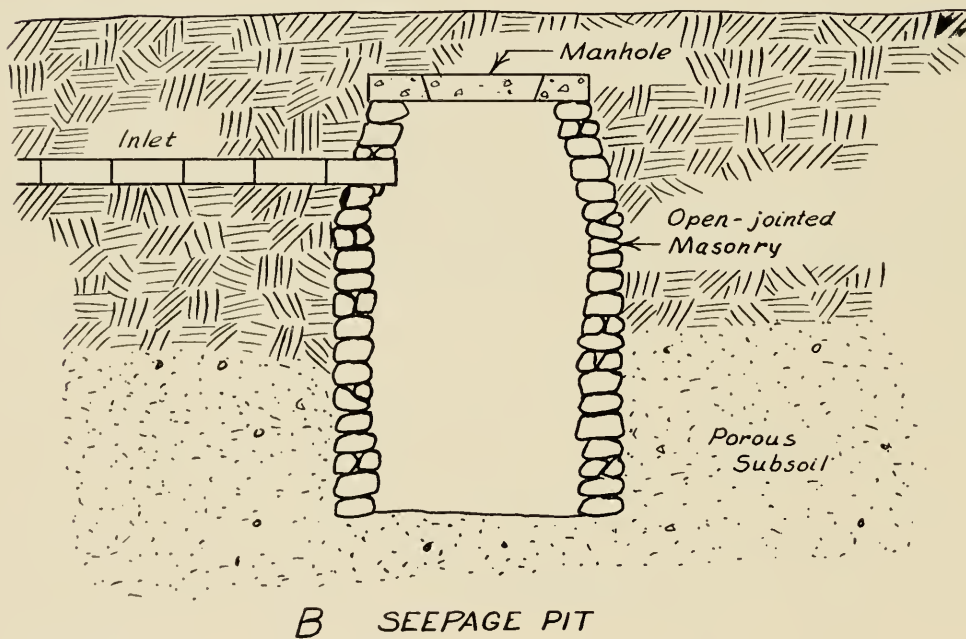
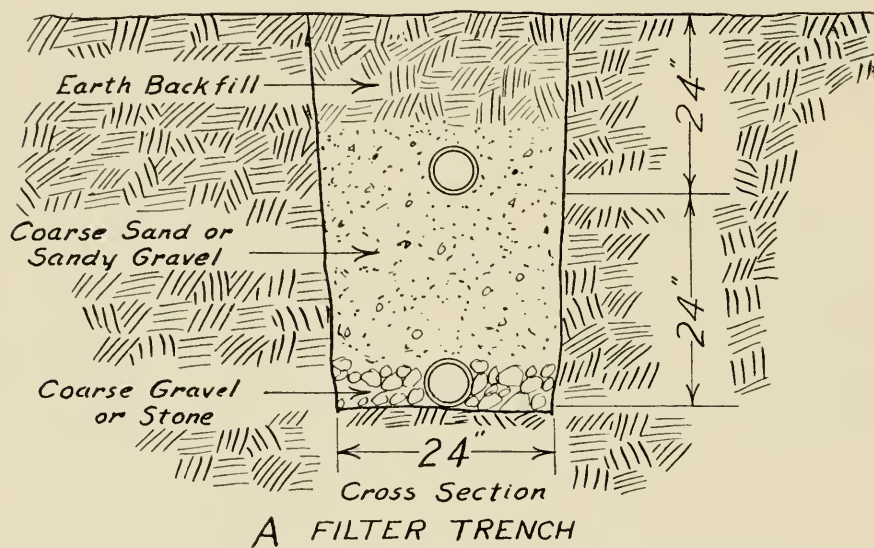
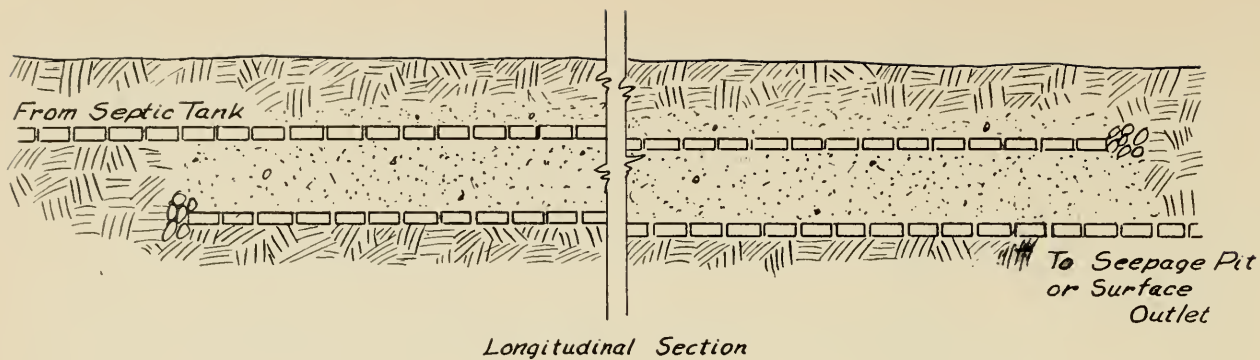


Figure 8—Special Methods of Effluent Disposal.

THE DOUBLE CHAMBER TANK WITH SIPHON

For institutions and large households of more than 12 people, and where local bylaws prohibit the use of a single chamber tank, a septic tank, with an added chamber which discharges intermittently, is used. This consists of the main chamber, or septic tank proper, similar to a single chamber tank. The outlet from this main tank leads to a smaller second, or dosing chamber which is fitted with a siphon which automatically discharges and empties it when the effluent reaches a certain level. The capacity of the dosing chamber should be such that the siphon will not discharge more frequently than once every eight hours.

Although double chamber tanks with a siphon are available prefabricated of steel, they are more commonly built of concrete.

Construction of the Double Chamber Tank

The dosing chamber is usually built at the outlet-end of the main chamber as shown in Fig. 9A, but where space or other limitations prevent this extra length being added, it may be built beside the main chamber as shown in Fig. 9B. If this is done the length and width may be altered to suit, taking care that the capacity is not reduced by the alteration.

The automatic siphon, which is available commercially, is installed at the bottom of the shallow dosing chamber. The dimensions given in Fig. 9 for depth of the dosing chamber are for a siphon with a 14 inch drawing depth. Where other siphons are used the depth should be altered accordingly.

For smaller installations the septic chamber may be built using the forms for the single chamber tank. To increase the size to the larger sizes shown in Table II and Fig. 9, additional panels in the sides may be added. Forms are not provided for the siphon chamber, but must be specially built.

Both chambers should be built at one time, to avoid weak joints in the concrete.

The siphon is placed as shown in Fig. 9 with the trap encased in concrete. It must be installed perfectly plumb, with the bead on the long leg of the trap flush with the top of the floor. Both legs of the siphon should be plugged during installation to keep out concrete or dirt. When the work is complete the plugs must be removed, the siphon filled with water, and the bell placed on it.

The tank is usually covered with a sectional slab top, made as recommended for the single chamber tank (Fig. 4). However, a one-piece top with manholes 20 inches square or 24 inches in diameter giving access to both chambers may be used on large installations.

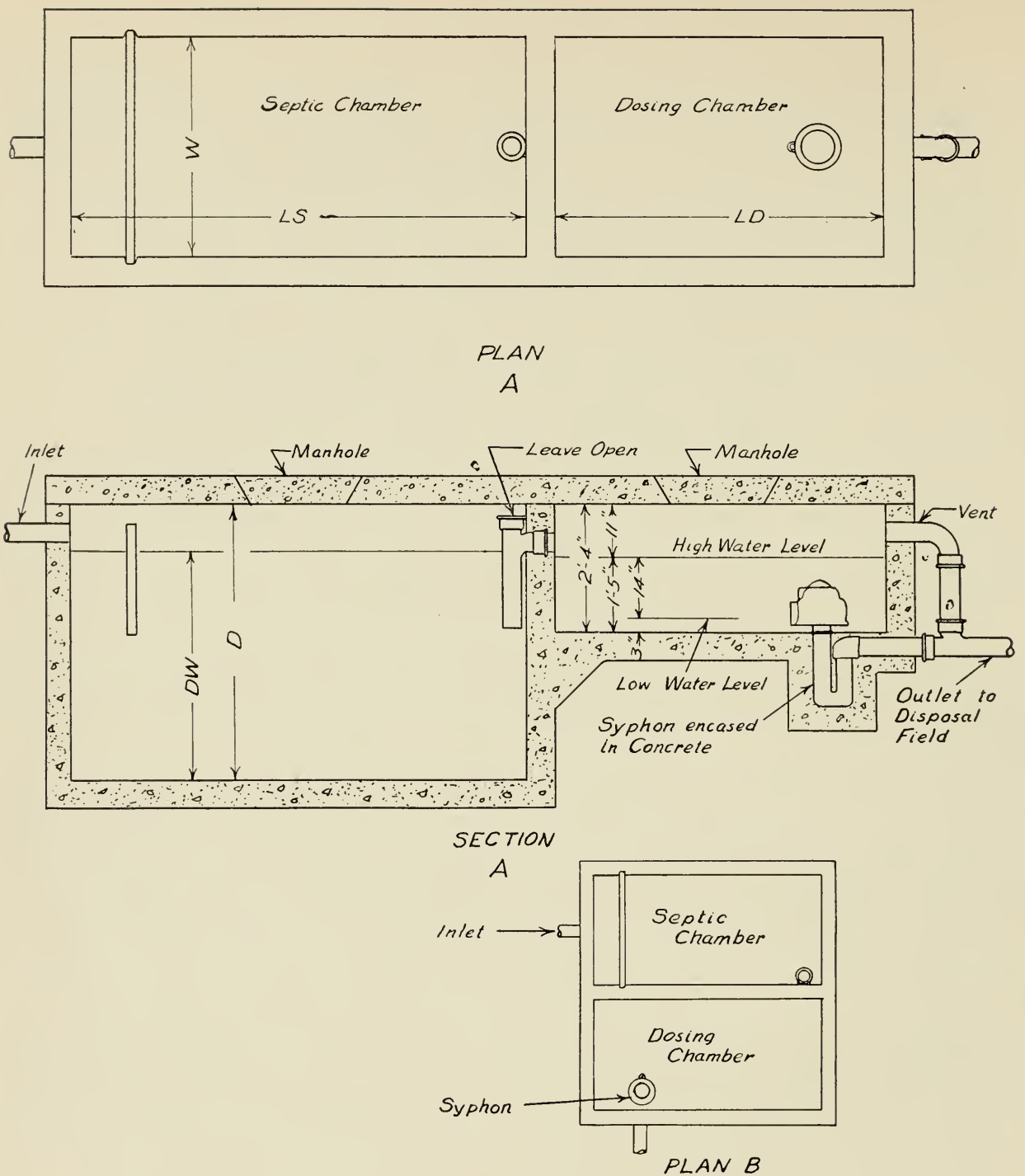


Figure 9—The Double Chamber Septic Tank with Siphon.

TABLE II

DIMENSIONS OF DOUBLE CHAMBER SEPTIC TANK

PERSONS	SEPTIC CHAMBER				Capacity Imp. Gal.	DOSING CHAMBER			Amount of 4" Tile
	LS	W	D	DW		LD	W	Capacity Imp. Gal.	
8 or less	5'	4'	5'	4' 2"	520	4'	4'	120	330
10	7'	4'	5'	4' 2"	720	5'	4'	150	455
12	8' 3"	4'	5'	4' 2"	860	6'	4'	180	495
14	8' 6"	4' 6"	5'	4' 2"	1000	6' 5"	4' 6"	220	600
16	9'	4' 6"	5' 4"	4' 6"	1150	7' 3"	4' 6"	240	660
18	10'	4' 6"	5' 4"	4' 6"	1300	8'	4' 6"	270	740
20	10'	5'	5' 4"	4' 6"	1450	8'	5'	300	820
25	11' 6"	5'	5' 10"	5'	1800	10'	5'	375	1030
30	11' 6"	6'	5' 10"	5'	2150	10'	6'	450	1240
40	13'	6'	6' 10"	6'	2900	13'	6'	600	1650

LS—Length of Septic Chamber.

W—Width of Septic Chamber.

D—Depth of Septic Chamber.

DW—Water Depth in Septic Chamber.

LD—Length of Dosing Chamber.

W—Width of Dosing Chamber.

(See Figure 9.)

The Disposal Field

Any of the methods of disposal used with a single chamber tank, except the seepage pit, may be used with the siphon tank. Where a tile disposal field is used the tank must be built at such a depth that the disposal tile may be laid within 24 in. of the surface. Since this frequently results in part of the tank extending above ground level, a terrace or mound will be needed to cover and frost-proof it. The amount of tile required is given in Table II. This should be increased in close soil and may be reduced one third in very well-drained soil.

OPERATION AND CARE OF THE SEPTIC TANK**The New Septic Tank**

Before using the new septic tank it should be filled with water. No other additives are required. In normal use, suitable bacteria will be present in the sewage to initiate septic action. The use of yeast or commercial preparations claimed to start or improve the action of a septic tank is unnecessary.

The septic tank, if of sufficient capacity, will handle all normal household wastes, including bath and wash waters. Where large quantities of soapy water or grease are added, as from laundries or restaurants, a grease trap is recommended, but this should not be necessary for the ordinary house.

Strong disinfectant solutions, lye, and milk wastes must not be permitted to enter the tank in quantity. Abrasive, rather than chemical, cleansers should be used for cleaning fixtures. Do not allow bulky materials, and paper other than toilet paper, to enter, as these are likely to plug the plumbing, and may be slow to decompose.

If the tank is of adequate size (500 gallons or over for the average family) ground garbage and coffee grounds may be permitted to enter, but will necessitate more frequent cleaning of the tank. Hypochlorite bleaches and the salt solution from regenerating water softeners are harmless in the quantities used in the ordinary home. However, excessively large quantities should be used with caution.

Cleaning

No septic tank can operate for long periods without cleaning. A floating scum forms on the water surface and may become thick enough to interfere with the action of the tank. Also an accumulation of insoluble solids is built up in the bottom of the tank in the form of a sludge. These

must be removed periodically otherwise they will be forced out with effluent, eventually plugging the tile. This will then necessitate digging up, cleaning and relaying the tile. The frequency of sludge removal varies with the size and depth of the tank and the amount and type of use. The depth of sludge should be checked every two years by inserting a stick through the top. When the sludge or scum on the surface is over a foot deep it should be removed. **When inspecting the tank do not use matches or an open flame** as explosive gases are frequently present. Sludge and scum may most conveniently be removed with a cistern or boat pump, holding the suction pipe near the bottom of the tank and moving it about. It is not necessary to empty the tank completely. If a pump is not available the tank may be emptied by bailing. Any sludge, scum, and liquid removed from the tank should be buried in a trench with 12 to 18 inches of earth cover.

Cold Weather Precautions

If the tank is covered with a foot of earth and the disposal field is at the recommended depth of 18 to 24 inches, no trouble with freezing should be experienced if it is in constant use throughout the winter. However, if in a cold area where there is likely to be little snow cover, it is advisable to cover the tank and disposal bed with a foot of straw, a layer of brush to catch the snow, or place a snow fence so that snow drifts over it. Since the greatest likelihood of freezing occurs where the driving of vehicles or tramping of cattle packs the soil and snow over the tile care should be taken to keep winter driveways away from the disposal field.

THE GREASE TRAP

Although a grease trap is not required for the ordinary household, it is advisable to use one where a large quantity of grease and soapy water is produced as in restaurants and boarding houses. It should be connected in the waste piping line serving the sinks and should have sufficient capacity for proper cooling and settling of the water passing through it. The liquid capacity should be from 2 to 4 gallons for each meal served in the busiest hour, with a minimum capacity of 30 gallons. The depth below the liquid level should not be less than 2 feet. It may be built of concrete, concrete tile, vitrified clay, or metal. The inlet and outlet should be opposite sides, with the outlet submerged.

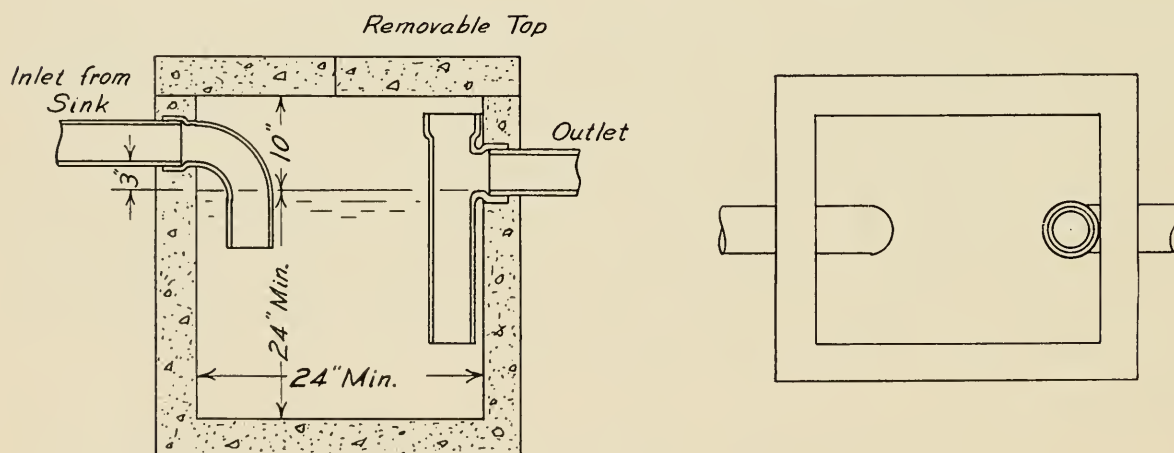


Figure 10—The Grease Trap.

The grease trap should be installed outside the building, as near as possible to the fixtures it serves, and accessible at all times for cleaning, with a removable cover or manhole. In the winter it will have to be covered with earth or some insulating material to prevent freezing. Frequent removal of the grease and sediment from the trap is necessary.

The effluent from the grease trap may enter the septic tank, or may be disposed of through a separate disposal field or seepage pit.

CESSPOOLS

A cesspool is not recommended for the disposal of sewage. It is simply a hole in the ground, similar to a seepage pit, into which raw sewage is discharged. The sewage enters the ground below the depth at which soil bacteria are active, with the result that the ground around the cesspool becomes seriously polluted and may contaminate water supplies at considerable distances. In many cases, the soil around a cesspool is soon plugged with sewage solids to the extent that seepage is seriously reduced and a new cesspool must be dug.

SEWAGE DISPOSAL WITHOUT WATER CARRIAGE

On those farms where running water is not available, a septic tank cannot be used. Some form of outdoor privy is the most common method of disposal. Although privies are less convenient than the water carriage system they may be kept clean and sanitary if properly constructed. A privy should be fly-tight, with the feces out of reach of insects, animals and surface water. It should be at least 100 feet from the well, preferably on a lower elevation, and should be mounded up to keep out surface water.

THE SEPTIC PRIVY

In this type of privy a water-tight tank is used to receive the excreta, and bacterial action similar to that in a septic tank tends to liquefy a large part of the solid matter. The tank has an outlet to a disposal tile through which the liquid passes into the upper layers of the soil, where it is rendered harmless and absorbed. To ensure proper operation of the septic privy it is absolutely necessary to add water each day.

Construction

A conventional type of privy building is built over a concrete tank as shown in Fig. 11. The tank may be built by using the septic tank forms referred to on page 6. Through the use of this type of construction the tank can readily be used as a septic tank when a full bathroom is installed at a later date. With this in mind, it is recommended that the tank be built as recommended in the section on septic tanks, complete with inlet and outlet fittings, and located for easy connection in the future to the bathroom. Such a privy tank may also receive the discharge from a sink, if such is installed in the house. Water from the sink may eliminate the necessity of adding water daily to the tank, but will make an increased amount of disposal tile necessary. Conversion to a septic tank will only require connection of the fixtures to the tank and enlarging the disposal bed. The disposal bed for 4 to 6 persons with no sink emptying into the tank, should range from 40 feet of 4 inch tile in light soil, to 70 in heavy soil. Where a sink empties into the tank this should be approximately doubled. This disposal tile should be laid as for a septic tank, though usually a single line of tile is used. For instructions on installing, see "The Disposal Field" and Fig. 6 in the section on Septic Tanks.

As the action of the bacteria in the tank gives rise to odorous gases the seat and riser must be tightly built. The riser may be of concrete, or double boarded with asphalted paper between. A vent stack should be carried from beneath the seat to well above the roof and screened to prevent the entry of insects. The building should be well ventilated and screened.

Operation

Before use the tank should be filled to the overflow with water, and unless a sink empties into the tank, two pails of water must be added each day. No paper other than toilet paper should be used, as it may be difficult to decompose and may cause plugging of the outlet. Ashes, earth, or disinfectants must not be used. A small quantity of oil or kerosene may be added weekly to prevent flies and mosquitoes from breeding in the liquid. A heavy scum may form on the liquid which must be broken up occasionally by stirring with a board or stick through the seat-hole.

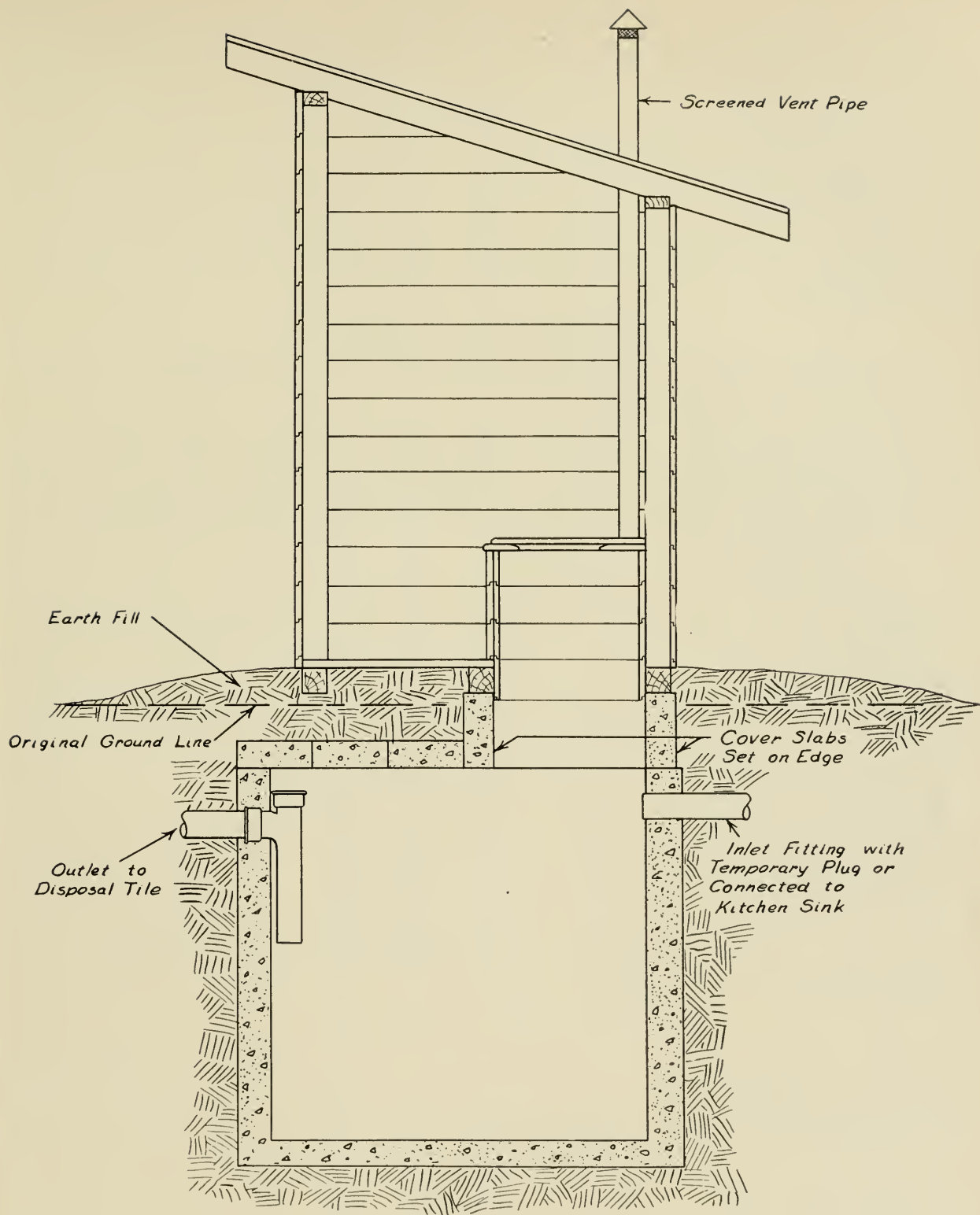


Figure 11—The Septic Privy.

The tank should be inspected every year to determine the depth of sludge. When sludge and scum take up one third the water depth of the tank it must be pumped or bailed out and buried, as recommended under "Operation of the Septic Tank—Cleaning."

SEPTIC TOILETS

Septic toilets are available commercially for indoor installation. They consist of a vitreous china bowl connecting with a steel tank by a straight drop pipe, with no trap, the whole being similar in appearance to the tank-type chemical closet shown in Fig. 12 (A). An outlet from the tank leads to a tile disposal line. For indoor installation it is particularly necessary to follow the instructions exactly for installation and care, to prevent odours in the house. Septic toilets are available as single units for home use, or multiple for churches, schools, and other rural institutions. Instructions for installation and care are available from the various manufacturers.

CHEMICAL TOILETS

Toilets are available commercially which depend on the action of caustic chemicals to destroy the sewage.

The simplest type is the commode type, shown in Fig. 12B, which consists of a riser and seat, with a pail beneath the seat to receive the excreta. This may be installed anywhere without need for pipes, except a vent pipe. The pail requires very frequent emptying and cleaning, and

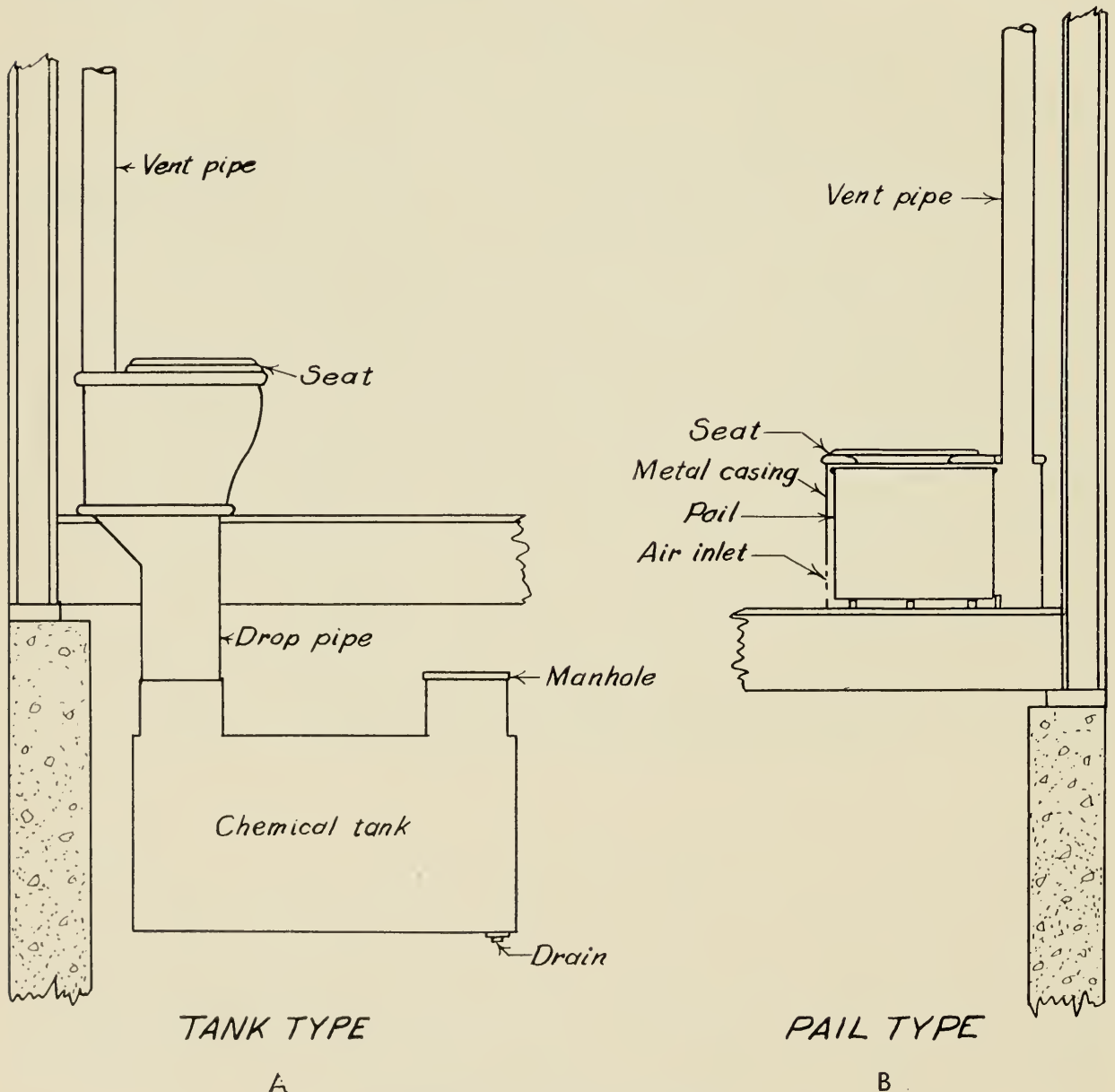


Figure 12—Chemical Toilets.

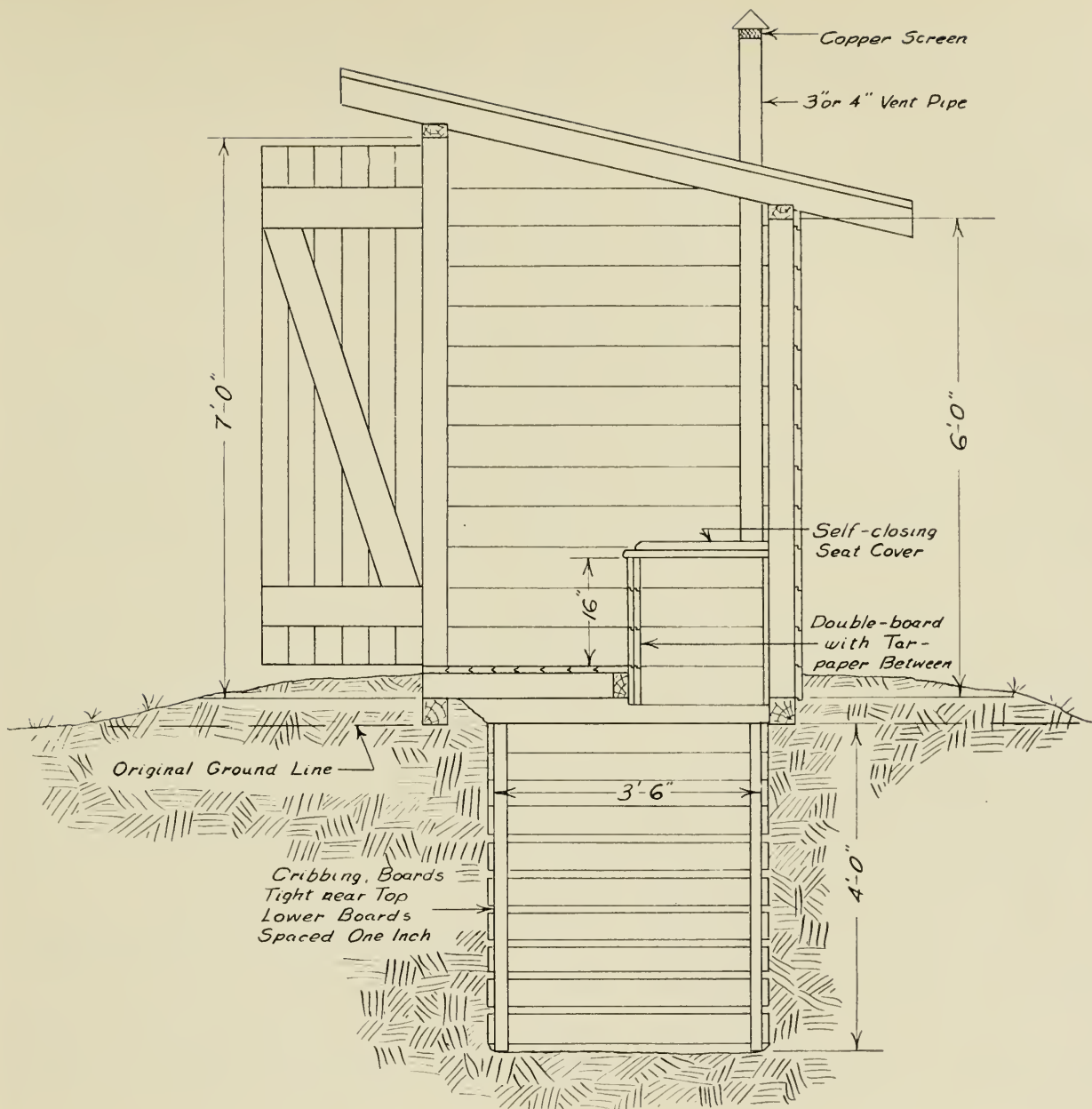


Figure 13—The Pit Privy.

must be recharged with chemical each time. Failing to add chemical results in odours and unless it is emptied regularly it may overflow. This type of toilet is not recommended, though it may be used temporarily where illness prevents the use of an outside privy.

The second type which requires much less frequent care is of the construction shown in Fig. 12(A), in which the feces are deposited in a large tank. This must be periodically emptied by pumping or draining and recharged with a caustic solution. Due to the much larger capacity of the tank, less frequent attention is required. An agitator is generally provided to break up the coarser solids and thoroughly mix them with the chemical solution. This should be operated daily or oftener.

The tank for this type of toilet is generally installed below the floor, with the manhole accessible from outside for cleaning; or a connection may be made to the drain-hole in the bottom of the tank leading to a seepage pit and the contents drained off periodically. The frequency of cleaning varies with use. The tank must always be recharged with a

solution of the caustic chemical after emptying. Failure to do this will result in very bad odours and make cleaning unpleasant and difficult. This type of chemical toilet is available in single and multiple units. The manufacturers' instructions should be followed closely in installation and operation.

Chemicals for this type of toilet are available from the manufacturers. A solution of 25 pounds of caustic soda in 15 gallons of water is used. Great care must be taken in handling the caustic soda and the solution, and it must not be stored where it will be accessible to children.

THE PIT PRIVY

The pit privy is the simplest form of privy and is satisfactory if properly constructed. The excreta is deposited in a pit dug in the earth, which is cribbed with open spaced boards to prevent the sides caving in. Bacterial action tends to liquefy some of the excreta, which is then absorbed in the soil. The deposit ultimately builds up until it becomes necessary either to move the building over a new pit, or to clean out the pit.

The privy building is usually built of wood, which makes it easy to move to a new location when the pit becomes full. A privy built with a concrete floor and riser, however, is easier to keep clean; but the pit will require emptying occasionally since the building is usually immovable. The building must be tightly built to exclude flies and well ventilated by screened openings. The pit should be vented as shown in Fig. 13 by a stack leading from beneath the seat. The earth dug out of the pit should be graded up to provide a slight fall away from the pit and building on all sides, and the roof should extend well back to prevent water from washing away this fill and entering the pit.

During the fly season half a pint of crankcase oil or kerosene poured over the contents of the pit once a week will prevent insects breeding. Lime or ashes should not be added.

Fig. 13 shows suggested dimensions for a pit privy. The width of the building and pit can be suited to the user's requirements and the number of seats. A 4-foot width with two seats is usual.

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TABLE TURNIPS (RUTABAGAS)

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B472

by

Staff Members of the Ontario Agricultural College,
Guelph, Ontario



ONTARIO DEPARTMENT of AGRICULTURE
STATISTICS AND PUBLICATIONS BRANCH, TORONTO, ONTARIO

TABLE TURNIPS (RUTABAGAS)

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ACKNOWLEDGMENT

Acknowledgment is tendered Mr. W. F. Strong, Supervising Inspector, Fruit and Vegetable Division, for his many helpful suggestions during the preparation of this bulletin.

GROWING AND HANDLING TABLE TURNIPS

G. P. McRostie and J. Laughland,
Department of Field Husbandry, O.A.C.

The following suggestions are based on tests made at the Ontario Agricultural College and on practices followed by many successful growers in Western Ontario.

The Soil and Its Preparation

1. Use good, clean, fertile, medium loam soil.
2. Cultivate at two or three intervals before seeding to destroy weeds.
3. Under average conditions apply 10 to 12 tons of farm manure and 375 to 500 pounds per acre of 0-16-8, or 2-12-10, as indicated by soil test. Where phosphate is deficient use 2-16-6 at the same rate.
4. Have the soil well worked just before seeding.
5. If ridging is done make the ridges low; 2 to 3 inches high is ample. A ridger is now available to make these low ridges.

The Seed

1. Buy registered seed of Purple Top Varieties. There is none better than Laurentian.
2. Be sure the seed is treated with Semesan or with corrosive sublimate for Black Rot. (See under Diseases.).

Seeding

1. One-half pound of seed per acre is ample.
2. If your seeder will not sow this amount uniformly, roast half the seed. To do this, place the seed for roasting, about one inch deep, in flat pans and roast in the oven for about 2 to 3 hours at 300°F. A very hot oven might burst or char the seed. Place a few of the roasted seeds between wet paper for two days to be sure none can sprout. Mix the roasted seed with the live seed, half and half, by pouring back and forth from one container to another. Sow the mixture at 1 lb. per acre.

OR The turnip seed may be sown through the fertilizer runs of a grain drill. Set the machine to sow 100 lbs. of fertilizer per acre. Leave every fourth spout open. Thoroughly mix one-half pound of seed with every 25 lbs. of fertilizer. If the drill cannot be set to sow this small amount, uniformly, use more fertilizer with the seed. This small amount of fertilizer is used only as a means to obtain uniform distribution of the seed and must not be considered as the fertilizer requirements. Do not mix the seed and fertilizer until just before seeding, otherwise injury to the seed may result.

OR Turnip seed can be mixed with chick grit of approximately the same size as the turnip seed. Mix at the rate of 14 cups of chick grit to 1 cup of turnip seed. Sow with the grain drill set on finest adjustment of wheat size.

Time of Seeding

The main crop is usually sown during the last two weeks in June.

Thinning

Thin when the plants are 1½ to 3 inches high. Thin to 6 to 8 inches apart. It is necessary to use a hoe of not more than 6-inch cutting edge. Six to eight inch spacing will give the highest yield and smoothest turnips.

Cultivation

Cultivate only for weed control and only to a depth of 1 to 2 inches. In other words merely "skim the surface". Avoid deep cultivation especially after the turnip roots begin to enlarge.

Grading

All turnips are packed and sold under specified grade requirements.

Canada No. 1—2 to 4 in. across (limited market).

Canada No. 1—3½ to 5 in. across, Canada No. 1—4 to 6 in. across (most popular sizes).

Canada No. 1—4 in. and up, across (dehydration and soup only).

Culls include those which are off shape, gouged, bruised or punctured, and also those containing growth cracks, worm injury, water-core, or any of the rot diseases such as Black Rot, Soft Rot, and Skin Rot.

Harvesting

1. There are some implements on the market which aid in harvesting but as yet most turnips are pulled by hand and trimmed with a sharp well-balanced butcher knife.
2. Cut off the tail end of the root 1 to 1½ inches below the butt and rub off any small side roots with the back of the blade. Cut off the top with a single stroke leaving ¼ to ½ in. of neck, but do not cut into the body of the turnip.
3. Pull and trim two rows at a time.

Handling

1. Once turnips are pulled, freezing or sunburning may make them culls.
2. The turnip fork should have knobs of sufficient size on the ends of the tines to prevent puncturing.
3. Bruising of turnips can be prevented by placing bransacks filled with straw under the chute for the first load, and against any sharp edges in the storage bin.
4. Never store culls along with shipping turnips.

WATER-CORE OR BROWN HEART OF TURNIPS AND CONTROL

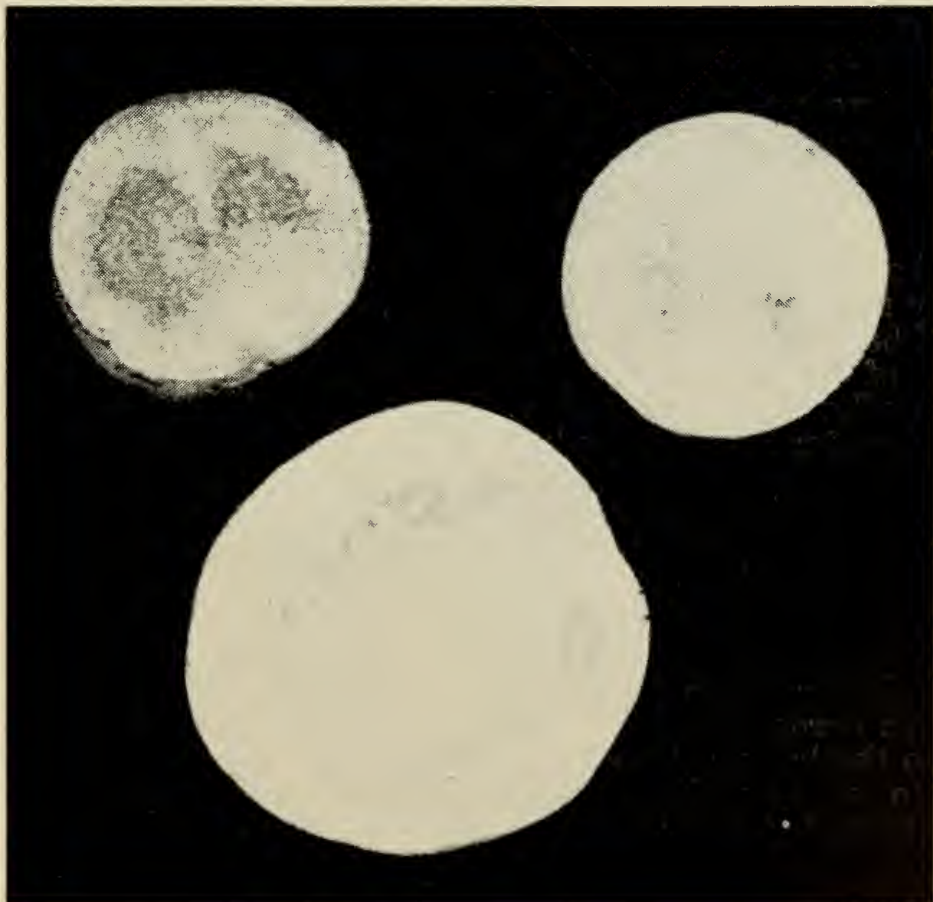
J. D. MacLachlan, Department of Botany, O.A.C.

Description

In the early stages of development the disease appears as water-soaked, but firm, patches in the turnip flesh. These areas may increase in size until almost the entire turnip is included. Severely diseased turnips may become brownish and punky inside, a condition more apt to be seen in storage than in the field in Western Ontario. It is practically impossible to detect slightly water-cored turnips without cutting them. Severely diseased turnips may be off shape and have a rough, corky to leathery skin.

Control

This disease is caused by lack of available boron in the soil. Soil applications of borax before seeding have not been successful in many districts possibly because of the high lime content of the soil. **Water-core can be controlled by spraying or by dusting the leaves.** If soil applications of borax must be resorted to because of lack of spray or dust equipment, broadcast **granulated borax after thinning** rather than before seeding, at the rate of 20 to 30 lbs. per acre with a hand, cyclone grass seeder.



Water-core.

DIRECTIONS FOR SPRAYING

The Sprayer

A power sprayer, either wheel or motor driven, that will give at least 125 lbs. pressure is preferred. A good agitator in the tanks is necessary. Use 3 spray nozzles per row, the centre one directed down on the leaves and the two side nozzles set as low as possible and directed toward each other. With a 4-row, hand-pump barrel sprayer, use three nozzles per row as described above and spray only 2 rows at a time. Forty to sixty gallons of spray should be applied per acre, depending on the size of the leaves.

When To Spray

Thoroughly spray the leaves when the roots are 1 to 1½ inches across (about the thickness of one's thumb).

Materials To Use

Borax—Obtainable from fertilizer and spray companies but should be ground finer than table salt. Borax contains boron, the material necessary to prevent water-core.

Bentonite Clay—Obtainable from fungicidal spray companies. The Niagara Brand Spray Co., Burlington, Ont., has it in stock. This holds the borax on the leaves so it will not be washed off by rains.

Orthex (liquid form)—Obtainable from fungicidal spray companies. This material is used to make the spray spread evenly over the leaves and also to help make the spray stick to the leaves.

Seed dealers can obtain these supplies. The Niagara Brand Spray Co., Burlington, Ont., mixes the borax and bentonite clay ready to use.

Making Up The Spray

If the borax and bentonite clay are not already mixed when purchased, thoroughly mix them while still dry in the proportions of 12 lbs. of borax to 3 lbs. of bentonite clay. Almost fill the spray tank with water. For each 40 gallons of water slowly add 15 lbs. of the borax-clay mixture while stirring rapidly. Then stir in 2 to 2½ cups of Orthex for each 40 gallons. Add enough water to fill the tank.

DIRECTIONS FOR DUSTING

The Duster

Potato dusters, also a large pea duster, have been used with good success. An apron should be used to assist in getting as much dust as possible on the lower sides of the leaves. From the results so far it does not seem to make any difference as to the time of day the dust is applied. However the dust outlets may clog if the leaves are very wet.

When To Dust

Similar to that described for spraying.

Materials

The Bartlett Spray Works, Beamsville, Ont., the Niagara Brand Spray Co., Burlington, Ont., and Canadian Industries Ltd., Toronto, Ont., prepare the borax-dust mixture ready to use.

Apply 40 to 50 lbs. of the dust to each acre of turnips. If using a potato duster it may be necessary to suspend a weight on top of the dust to prevent arching of dust at the bottom of the hopper.

TURNIP ROTS AND THEIR CONTROL

J. D. MacLachlan, Department of Botany, O.A.C.

E. H. Garrard, Department of Bacteriology, O.A.C.

The following is a description of the important rots in turnips and the most effective known means of control.

Black Rot

(Caused by *Xanthomonas campestris* (Pammel) Bergey et al)

Description

The disease gets started in the field from using untreated seed and from diseased turnip or rape refuse remaining in the soil from previous years or brought to the field in manure. It may also start from neighbouring diseased fields. At first scattered diseased plants will occur throughout



Black rot (upper left) rind removed from one side of a turnip to show characteristic black streaks. (Other three) cut turnips showing various amounts of disease.

the field and are often unnoticed by the grower. From these diseased plants, however, the bacteria causing the disease are spread by wind, rain and insects to various parts of the field where they attack healthy plants. The disease is first seen on these plants as yellowish areas usually near the margin of the leaf; the veins in these areas are often blackened. The bacteria work down through the leaves, killing the leaf tissue as they go, and finally get into the root. There, they cause black streaks just under the rind or black areas throughout the flesh and render the turnip unfit for sale. The same bacteria will attack other closely related plants such as rape, cabbage and cauliflower.

Control

1. Practise as long a rotation as possible so that the bacteria causing this disease and remaining in the soil will die out. A four or five year rotation should be ample if rape, cabbage or cauliflower have not been included.
2. Avoid putting manure containing turnip refuse on a field in which turnips are to be grown. It is also advisable not to use manure from stock fed on diseased turnips.
3. Use treated seed. If the seed has not been treated with a mercury compound when purchased, it can easily be done. One of the simplest and easiest is the use of Semesan dust. It is available in most places where turnip seed is sold and a 15c package treats 5 lbs. of seed; this is at the rate of one-half level teaspoonful of the dust to one pound of seed. Half fill a large glass bottle such as a gallon vinegar bottle, or tin container which is fitted with a tight-fitting top, with seed, add the proper amount of dust and shake thoroughly until the dust is uniformly



Soft Rot (lower right) diseased turnips from which the top has fallen away because the neck was rotten. (Other two) cut turnips to show soft jelly-like rot.

distributed over the seed. The seed can be treated any time prior to sowing and it is well worth the effort and small expense. **Caution—**Semesan is poisonous; avoid breathing the dust.

4. Weeds of the mustard family may carry the disease. Therefore, do not allow mustard to grow in the turnip field.
5. The bacteria causing the disease may be carried from diseased to healthy turnips by insects, including slugs and maggots. Anything that can be done to control insects in the field will help to prevent the spread of Black Rot.
6. The disease may also be spread by working in the field while the leaves are wet. It is safer to hoe or cultivate when the leaves are dry.
7. Do not store diseased turnips.

Soft Rot or Neck Rot

(Caused by *Erwinia carotovora* Jones)

Description

Evident in the field as sickly tops, or if one attempts to pull a turnip with an apparently healthy top the latter breaks away readily at the neck revealing a soft rotten mass. The flesh of the turnip may be partially or almost entirely decayed into a soft jelly-like mass with no distinct odour at first but later becoming putrid. The disease may start in the field and increase during storage. It is caused by a different bacterium from the one which causes Black Rot. It should not be confused with water-core.

Control

Seed treatment is not known to control this disease but the cultural practices already described for the control of Bacterial Black Rot should assist materially in lessening the amount of this trouble. In a field where Soft Rot has been present do not grow, for at least four years, truck or vegetable crops such as mangels, carrots, cabbage, cauliflower, beets, onions, rape and lettuce. Even potatoes may be affected. **Never put turnips containing Soft Rot in storage** because it will spread rapidly to other turnips.

Skin Rot or Phoma Rot

(Caused by *Phoma lingam* (Tode) Desm.)

Description

Skin Rot is primarily a storage trouble. This disease begins in the field where it may sometimes be seen as a dry rot around the neck, but more often it is not detected until after the turnips have been stored for some time. During storage the disease appears in the skin as scattered, dry, sunken spots bordered by dark areas. If diseased turnips are waxed they will rot rapidly. The bacteria causing Soft Rot often attack turnips with Skin Rot.

Control

1. So far as is known, seed treatment will not prevent this disease.
2. Practise a long rotation because this disease starts in the field.
3. Avoid putting manure containing turnip refuse on a field in which turnips are to be grown. It is also advisable not to use manure from stock fed on diseased turnips.
4. Keep the storage as close to 32°F. as possible and have sufficient air circulation to prevent sweating.
5. If diseased turnips have been stored, thoroughly clean the storage room after the turnips have been removed. (See under Storage.)

TURNIP INSECTS AND THEIR CONTROL

H. W. Goble and J. G. Oughton, Department of Entomology, O.A.C.

The most important insects on turnips in Ontario are the root maggots. The striped flea beetle, cabbage and turnip aphids (lice) and to a lesser extent four caterpillars also cause damage. The aphids at times may be very serious but severe attacks are limited to certain years.

Root Maggots

Hylemya brassicae (Bouche) and *H. floralis* Fallen

Description

The root maggots which are the most serious pest of turnips are found also in the roots of cabbage, cauliflower, radish and other plants of the mustard family. Their burrows on the surface and in the interior of the root greatly reduce the market value of the crop and increase the cost of trimming.

Control

Various new insecticides are being tested but at present there is no effective, cheap and safe means of control. Damage by the root maggot may be reduced by attention to the following points:

1. Last year's turnip field

Turnips should not be allowed to grow up and flower in last year's field. They may support an early brood of root maggots, which may mature in time to infest the later crop. The field should be deeply ploughed and thoroughly worked, as early as possible. This will kill some of the wintering stage of the pest.

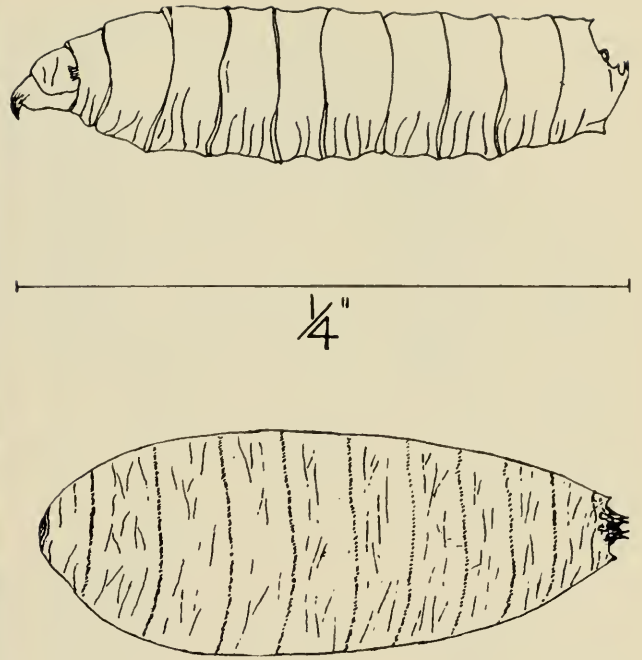
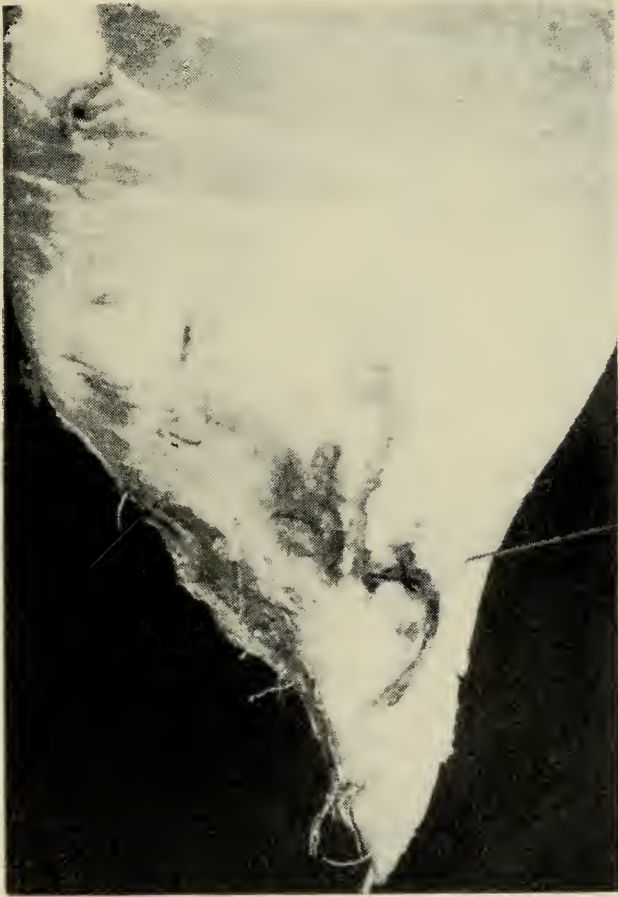
2. This year's turnip field

Choose a field which is as far away as possible from all turnip fields (your own and your neighbours') of the previous year. Some growers believe that manure and rotting sod attract the pest. We do not know if this is true. To be on the safe side, plough under the manure or sod in the fall and then in the spring work well with the disc.

Keep the fence rows clear of weeds.

3. Root cellars

These may help to carry over the hibernating stage. As soon as the cellar is empty, carefully clean the floor and bury the refuse at least a foot deep.



Left: maggot burrows in a turnip. Right upper: a mature root maggot (larva).
Lower: the resting stage (puparium) found in the soil.

Striped Flea Beetle *Phyllotreta vittata* (F.)

Description

The adults are small black beetles, 1/12 inch long with a wavy, inconspicuous yellow stripe down each wing cover. These beetles hop like fleas and thus are often called the "turnip fly". They attack the young plants shortly after they come through the ground and may eat so many holes in the leaves that the plants wither and die.

Control

1. Treating the seed with turpentine has no value.
2. Destroy weeds of the mustard family such as all kinds of mustard, peppergrass and shepherd's purse.
3. Dust the young plants, if attacked, with 3% DDT dust. If spraying is the alternative to be followed, spray the young plants with 50% DDT wettable spray powder at the rate of 1 lb. to 40 gals. water.
4. Turnips sown after June 21st are seldom severely injured. If early sown turnips are destroyed it is usually safe to resow, the second planting generally being free from flea beetle attack.

Cabbage and Turnip Aphids

Brevicoryne brassicae (L.) and *Rhopalosiphum pseudobrassicae* (Davis)

Description

There are two species of aphids that attack turnips. These are the so-called "cabbage aphid" and "turnip aphid". The cabbage aphid is covered with a whitish powder while the turnip aphid is green. In many cases both species are found on the same plant. Both the young and adults of these pests suck the juice from the leaves causing them to curl and the leaves to turn to a sickly yellow colour. If the attack is severe, the plants may be killed. Occasionally the attack is severe enough to destroy whole fields. When a field is destroyed late in the season, rot develops following the attack, the field giving off a strong odour of decay. Severe attacks occur in cycles, usually about one year in five.

Control

Chemical control on a field basis cannot be recommended at the present time. Some of the newer insecticides show promise but it is not known whether they will taint the crop. Nicotine as a dust or spray has not proven to be effective enough on a field basis. Points which should be kept in mind are:

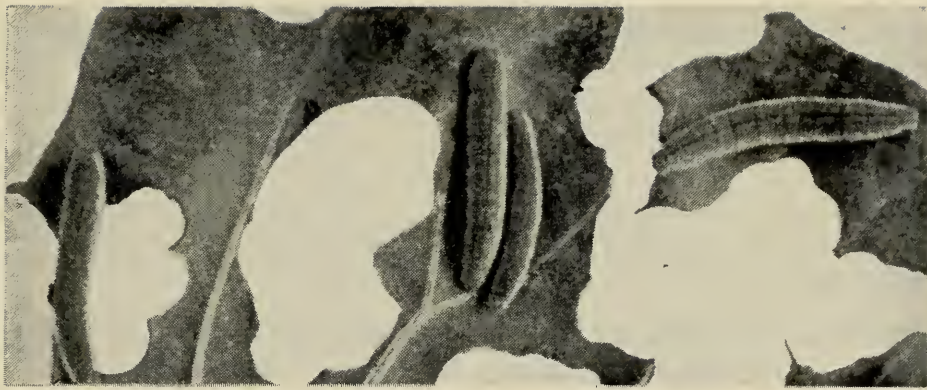
1. After the aphids have spread over the turnip field it is too late to attempt control because there is apparently no equipment yet available with which the aphids on the underside of the leaves can be destroyed.
2. Because of the difficulty in controlling the insects, prevention plays a big part in satisfactory turnip production. Be on the watch for the first infested areas in the field. These areas are at first small and usually found within the first ten rows around the field. Destroy the aphids in these infested areas by (a) thoroughly spraying both sides of the leaves of infested plants with a solution of 1 lb. of linseed oil soap in 10 gals. water or
(b) pulling the infested plants and burying on the spot. It is important that this be done while the infested areas are small, otherwise the winged females will spread the aphids to other parts of the field.
3. Plough down all turnip refuse in the late fall.

Leaf-eating Caterpillars

There are several species of caterpillars that attack the leaves of turnips. The damage is usually not severe enough to justify spraying or dusting. In 1948 this was not the case and many fields were almost completely defoliated. Four of the more common forms are

- (1) Imported cabbageworm, *Pieris rapae* (L.) (adult is the cabbage butterfly),
- (2) Cabbage looper, *Trichoplusia ni* (Hbn.),
- (3) Zebra caterpillar, *Ceramica picta* (Harr.),
- (4) Diamond-back moth, *Plutella maculipennis* (Curt.).

See the illustrations for the imported cabbageworm and the zebra caterpillar.



Imported cabbage worms, natural size (after Britton).



Zebra caterpillar and adult.

For most years no control is necessary but at other times, as for example in 1948, a spray or dust is necessary on some fields. Use either a 3% DDT dust at the rate of 30 to 40 lbs. to the acre or spray with 1 lb. of 50% DDT wettable powder in 40 gals. of water.

Caution:

Do not use DDT if the tops are to be fed to cattle. If such is the case, use derris (rotenone) in place of DDT.

THE STORAGE OF TURNIP ROOTS

J. H. L. Truscott, Department of Horticulture, O.A.C.

Losses in stored turnip roots are often serious and in many instances the loss is due to unsuitable storage conditions. Sometimes the storage structure is at fault and sometimes bad storage conditions are the result of mismanagement.

It is unfortunate that the impression is prevalent that the turnip can survive considerable mistreatment. Actually they must have carefully controlled conditions to remain in good condition during several months of storage.

It is not possible to describe here a suitable storage structure but the information is available. Some of the important points in the management of a turnip storage are as follows:

- (1) Clean out the storage thoroughly. Spray all surfaces (cover all metal) with a mixture of copper sulphate (bluestone), hydrated lime and water. The copper sulphate is dissolved in water using 2 pounds of copper sulphate to 10 gallons of water. Then add about 4 pounds of hydrated lime.
- (2) Use bin structures to keep the roots off the floor and away from the walls so that air can circulate freely.
- (3) Store only sound roots of sizes suitable for the trade.
- (4) Keep the storage air temperature between 31° and 32° F. by artificial refrigeration or by controlled ventilation.
- (5) Keep the humidity high (above 90%) at all times. A continuously wet storage floor aids in maintaining the humidity.
- (6) Pile the roots not over 6 feet deep.



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RASPBERRY AND BLACKBERRY CULTURE

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ONTARIO DEPARTMENT of AGRICULTURE
STATISTICS AND PUBLICATIONS BRANCH, TORONTO, ONTARIO

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RASPBERRY AND BLACKBERRY CULTURE

By J. F. Brown, B.S.A., Horticultural Experiment Station, Vineland Station

INTRODUCTION

The raspberries under cultivation in Ontario fall naturally into three main groups, namely, the red, the black and the purple. Blackberries and dewberries form another group. The red raspberry, however, is by far the most important of these and next to the strawberry, it is the most important small fruit grown in Ontario and also in Canada.

The Dominion Census does not give separate production figures for the three types of raspberries, neither are blackberries and dewberries separated. It is to be understood, therefore, that the following quantities and prices include both black and purple along with the red, and that dewberries are included with blackberries.

In 1920 Canada produced approximately 8,360,000 quarts of raspberries, of which Ontario's share was about 6,195,000 quarts and the price averaged 22 cents per quart.

Production in Canada for 1925 dropped to slightly less than 2,000,000 quarts, of which quantity Ontario produced one-half.

In 1930 about 5,600,000 quarts were produced in Canada and of this amount Ontario produced 3,100,000 quarts and the average price was 17 cents per quart.

By 1935 total production for Canada had increased to 7,690,000 quarts, but Ontario's share had dropped to 2,640,000 quarts and the average price was only 13 cents per quart. A rather noteworthy feature in raspberry production is the increase reported from Quebec, where it rose from 635,000 quarts in 1930 to over 2,500,000 quarts in 1935. The average annual production for Canada from 1931 to 1935 was about 6,400,000 quarts and the average price was 13 cents per quart.

The total area in raspberries for Ontario in 1940 was 4,140 acres (Monthly Crops Report issued by the Statistics Branch, Ontario Department of Agriculture) with a crop of 5,864,700 quarts, which sold for \$557,400, giving a price of just over 9½ cents per qt. In 1941 the area was 4,000 acres and the crop was only 4,057,700 quarts which sold for \$668,600, an average of 16 cents per quart.

With a decrease of 3.4 per cent in acreage there was a decrease of 30.8 per cent in yield, although on account of better prices the crop was worth more.



Picking red raspberries in Ontario. Note type of carrier in foreground.

This decrease in yield undoubtedly was due to weather conditions. In 1940 there was ample rainfall just prior to fruit ripening and picking while in 1941 there was a notable shortage of rainfall.

The main raspberry producing district in Ontario has been the five counties bordering the western end of Lake Ontario, namely, Lincoln, Wentworth, Halton, Peel and York. In 1920 this district produced almost 39 per cent of the total crop, while in 1930 the percentage was up to nearly 54 per cent. Other important producing counties were Norfolk, Elgin, Northumberland, Ontario, Simcoe, Middlesex, Prince Edward and Welland, which in 1930 produced about 33 per cent of the total crop.

According to figures in the above-mentioned crop report the distribution of raspberry acreage has changed somewhat in the last ten years or so as shown in the following table:

	1940		1941	
	% of Acreage	% of Crop	% of Acreage	% of Crop
East of Toronto	62.3	54.8	63.1	49.8
West of Toronto	37.6	45.2	36.9	50.2

The total blackberry crop for Ontario in 1930 was about 200,000 quarts and the price averaged just over 17 cents per quart. The four main producing counties were Lincoln, Halton, Wentworth and Peel, which produced about 60 per cent of the total. Six other counties, namely, Essex, Kent, Welland, Northumberland, Lambton and Simcoe, accounted for another 23 per cent.

VARIETY RECOMMENDATIONS

Arranged in order of maturity, from early to late.

LIST No. 1

Commercial Planting

LIST No. 2

Limited Trial Planting

RED RASPBERRIES (GENERAL)

Viking
Newburgh
Latham

Madawaska
Trent
Taylor

RED RASPBERRIES (KINGSTON, EAST)

Trent
Viking
Latham

Rideau
Newburgh
Ottawa

BLACK AND PURPLE RASPBERRIES

(B indicates blackcaps, P purple varieties)

Cumberland (B)
Morrison (B)
Columbian (P)
Sodus (P)
Marion (P)

Bristol (B)
Dundee (B)
Naples (B)
Potomac (P)

BLACKBERRY

Eldorado

Lowden

THE RED RASPBERRY

The red raspberry is known in Europe as *Rubus Idaeus*, and probably has been cultivated since the 16th century.

The American red raspberry is classified by some botanists as *Rubus Idaeus*, variety *strigosus*, while others call it simply *Rubus strigosus* believing it to be a separate species from the European type.

It is estimated that between three and four hundred varieties of red raspberries have been grown at some time or other on the North American continent. Some of the newer varieties which appear to be worth mentioning are Durham, September, Sunrise, Tweed, Willamette. These varieties have not yet been fully tested at Vineland but reports from other stations and nurseries, with observations here, indicate they are worth mentioning. Descriptions will be found in the variety notes below.

Brighton—This variety was originated by Dr. William Saunders of Ottawa in 1887, and was introduced in 1907 by the Central Experimental Farm. A moderately vigorous grower and good plant maker. Somewhat susceptible to mosaic. Fruit medium or less in size, dark red and soft. Useful for earliness on local markets. Apt to suffer from red spider in dry seasons.

Chief—Originated at the Minnesota Fruit Breeding Station and is reputed to be a seedling of Latham. It produces a nice type of plant, vigorous and upright with plenty of suckers. It is quite hardy and appears to resist mosaic. The fruit is of medium size and of fair quality. Chief is only moderately early, being a day or two earlier than Viking. May have value in colder sections where better varieties cannot be grown.

Count—Very much like Brighton in plant and fruit. Reputed to do better on the heavier types of soil. Brighton and Count are still grown for first early, but should be dropped as soon as some other early is sufficiently proven.

Cuthbert—This variety has been grown more extensively than any other, not only in Ontario, but in most of the raspberry growing districts of Canada and the United States. It originated in 1865 as a chance seedling in the garden of Mr. Thomas Cuthbert at Riverdale, now part of New York City, and has been known under several names such as Conover, Queen of the Market and Quimby's Favorite. Its parentage is not definitely known although it is thought that it may be a seedling of Hudson River Antwerp as it was found growing near a plantation of that variety. Hedrick in "Small Fruits of New York" states that "the Hudson River Antwerp is supposed to have been brought to America about 1817 by a Mr. Briggs of Poughkeepsie, New York, who obtained it from the garden of the Duke of Bedford in England."

Cuthbert is a vigorous grower, makes almost too many suckers, and bears good crops of dark red fruit. The dark colour is objected to by some as the berries are apt to look stale on the fresh fruit market in a comparatively short time. Cuthbert has been in demand as a canning and freezing berry because of its undoubted high quality and the rich colour of its juice and fruit. As a shipping berry it is usually very fair to good although it is not as firm as several other varieties.

Its chief weaknesses are its susceptibility to virus diseases (mosaic, etc.) and its lack of complete hardiness; it may winter kill rather badly in some seasons especially in exposed locations. For these reasons Cuthbert is not planted nearly as extensively now as formerly and will probably be planted even less in the future.

Durham—An introduction from New Hampshire. This fall bearing variety is getting some attention because of the earliness of its fall crop. Fruit is round, medium size, deep bright red. Summer crop is fairly early, about with Viking.

Gatineau—A recent introduction from the C.E.F., Ottawa. At Vineland this variety lacks vigour and makes a rather poor plant. However, it is so early, coming in with Starlight, that it may have a place as a first early. It yields well for the size of the plant, and the berries are larger than Brighton and of better quality.

Herbert—A chance seedling found in the garden of R. B. Whyte of Ottawa. On good soil the plants are tall and vigorous but new canes are likely to be sparse. While it is very hardy and does very well in some areas it has never shown up to advantage at the Horticultural Experiment Station. The fruit is medium to large, of fair quality, sometimes soft and crumbly. It comes in about Cuthbert season and like Cuthbert is being superseded by more recent varieties.

Indian Summer—This is a new introduction from Geneva, N.Y. It is a moderate grower and produces plenty of suckers. It gives an early-summer crop and a fall crop. It is probably no better for its early crop than Brighton, the fruit being rather dark and soft, and the fall crop ripens so late that it is sometimes spoiled by frost.

Latham—This variety originated at the Fruit Breeding Station in Minnesota and was first distributed in 1912 as Minnesota No. 4. This is a vigorous grower and makes plenty of new shoots. The canes are rather slender and willowy and are of a deep purplish colour. It takes mosaic, also it mildews rather badly in some seasons. It yields good crops of large fairly attractive fruit, which is moderately firm but apt to be crumbly on the lighter soils. The quality is only fair. This is, no doubt, one of the hardiest of the large-fruited reds and thrives better under adverse conditions of heat, drought and cold than most other varieties.

Lloyd George—This variety has attained prominence in England and has received considerable publicity in Ontario. It is of only moderate vigour and not any too hardy. The fruit is large and long-conic, bright and attractive in appearance and of good quality but acid. Its main faults in Ontario are lack of robustness and poor cropping ability. It ripens early. Useful in breeding work on account of its earliness and size of fruit.

Madawaska—An Ottawa (C.E.F.) introduction. A better grower than Gattineau but several days later. It is a good cropper and the fruit is medium to large in size, of fair quality but somewhat acid. Round-conic in shape and moderately firm. A bit dark in colour, probably useful as a jam berry. A Collingwood grower and processor reports good yields and excellent processing qualities.

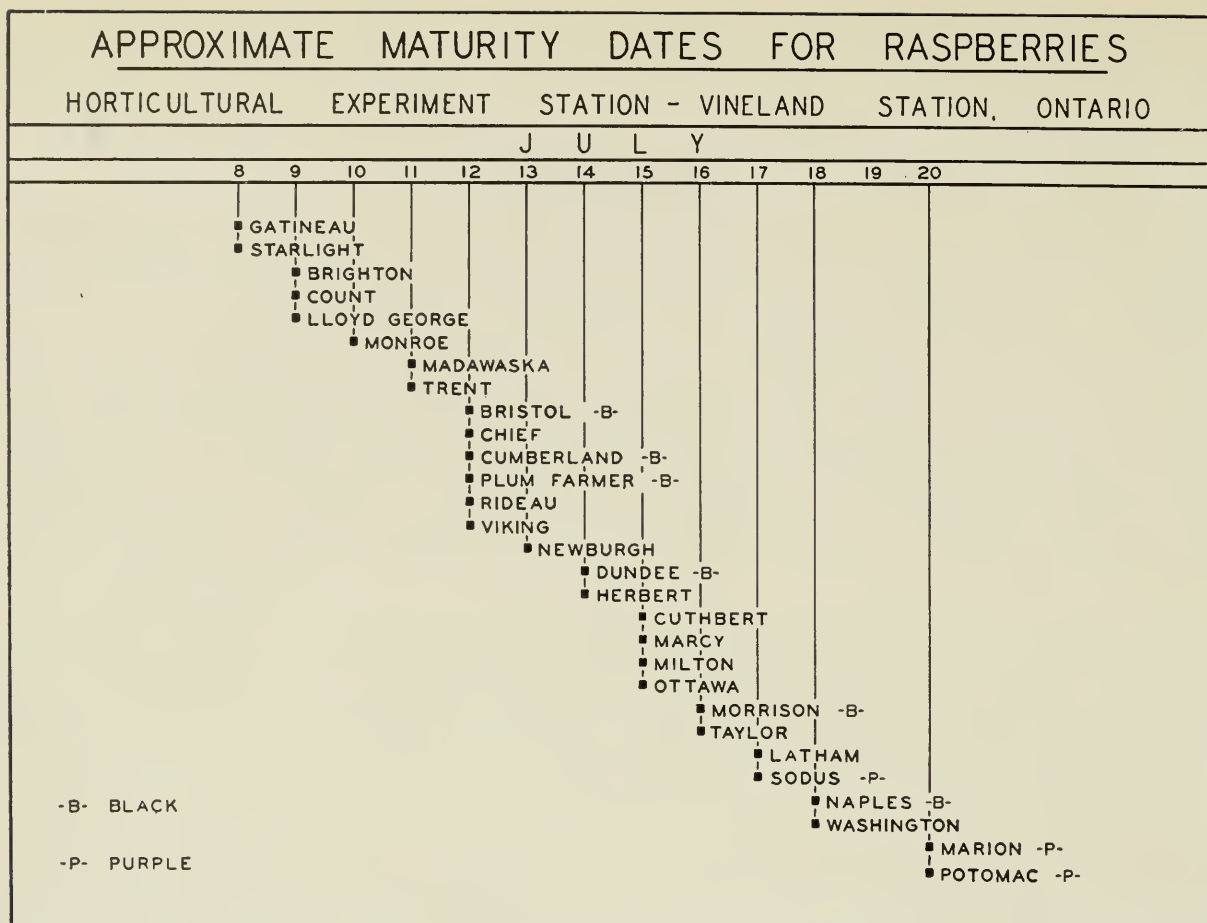
Marcy—Originated at the Agricultural Experiment Station at Geneva, N.Y., from a cross between Herbert and Newman. It is a vigorous grower, apparently resistant to mosaic, canes sturdy and fairly tall and upright. It yields well and the fruit is quite large. On the right type of soil (heavier than at Vineland) it produces a fine conical berry but on some soils it is apt to be rough and unattractive. Ripens about with Cuthbert.

Milton—Owing to an error in labelling, the variety grown at Vineland under this name is not the true Milton, so that no information is available on its performance here. However, Geneva lists Milton as being tall, vigorous and hardy with large long-conic, bright red fruit, firm, sub-acid and of good quality. It is apparently resistant to mosaic.

Newburgh—Another Geneva, N.Y., seedling from a cross between Newman and Lloyd George. It is quite resistant to mosaic and quite hardy in most areas although it has been known to freeze back some years. The fruit is very large, roundish, firm and very meaty, of fair to good quality. The fruit does not pick readily until well ripe. It is a good cropper and ripens in early mid-season, about with Viking.

Newburgh has a rather low spreading growth-habit. There is a tendency on the part of some growers not to head it back because of its low growth but this is a mistake. The canes should be headed back and the laterals shortened or they will bear more fruit than they can properly size and mature.

Newman (Newman 23)—Originated by Mr. C. P. Newman of Ville la Salle, Quebec. It is probably an open-pollinated seedling of one of the following varieties: Herbert, King, Loudon, Cuthbert or Eaton. This variety has not shown up to advantage at the Horticultural Experiment Station although it is grown to some extent in the colder parts of Ontario.



Above chart from Bull. 430.

At Vineland it is of fair vigour, yields moderately well, and the fruit is very firm. It is a rather dry berry of only fair quality. Ripens with Cuthbert.

Ottawa—A variety from the C.E.F., Ottawa. Ripens in Cuthbert season. At Vineland it grows too poorly to warrant recommendation for trial in the Niagara area.

Rideau—An Ottawa (C.E.F.) variety. Perhaps rather better at Vineland than the Ottawa. A fair grower and moderate cropper. Flavour fair, mild and flat. Ripens with Chief.

September—A recent variety from New York introduced for trial for home use. Bears a crop of fair quality, medium-size berries in July and a crop of good quality fruit in fall coming in about a month ahead of Indian Summer. Plants are vigorous and hardy.

Starlight—This variety has some merit as a first early for local markets but at Vineland the fruit has been too small and soft to be of any value. Probably better adapted for heavier soils.

Sunrise—A new early raspberry from the U.S.D.A. Fruit round, medium size, mild sub-acid in flavour. Appears to take mosaic fairly readily. Probably not as good as some of the new early varieties from Ottawa.

Taylor—One of the best of the Geneva, N.Y., seedlings. It is from a cross between Newman and Lloyd George. A vigorous grower, sturdy,

upright, and forms plenty of young shoots. It is hardy but takes mosaic rather freely although the symptoms are readily seen, making roguing easy. It is a good cropper and the fruit is large, conic, bright red and firm. In quality it is good, and it is moderately acid. Ripens rather late, with Latham.

Trent—As it grows at Vineland, Trent is probably one of the best of the recent introductions from the C.E.F., Ottawa. A very fair to good grower. Yields moderately well. Fruit is of medium size, only moderately firm. Of fair quality and rather dark in colour. Ripens with Madawaska or a day or so ahead of Viking. It seems to have some promise as a jam berry.

Tweed—New variety from Ottawa which shows some promise as an early. Fruit is round, medium to large, dark red colour, fair quality. Tendency to crumble unless picked correctly. Slightly susceptible to anthracnose and spur blight in some locations. Gives some heavy pickings early in season.

Viking—(Seedling 14038 of the Horticultural Experiment Station.) Viking originated from a cross between Cuthbert and Marlboro made in 1914. It is a vigorous grower, producing a moderate number of tall thick canes which are of such strength that they remain upright without trellising when loaded with fruit. This means much in cleanliness of fruit and ease of picking; it also facilitates cultivation and other operations during the picking season. The canes are almost entirely free of spines which makes picking easier and pleasanter.

It takes mosaic but the symptoms usually show up fairly clearly so that it can be readily rogued. In some localities it is apt to freeze back, more especially on poorly drained soil. It is a heavy cropper of large, bright, lively red fruit which is firm and of very good quality. For the "quick-freeze" method of preserving it is first class, being one of the best, although for canning it is not quite as desirable as Cuthbert on account of its light colour. It ripens in early mid-season, several days earlier than Cuthbert.

There have been quite a number of reports of winter killing in Viking in southern Ontario. This does not appear to be due entirely to a lack of hardiness because it has shown up as quite hardy in Quebec. The trouble in the Niagara peninsula and adjacent areas is undoubtedly caused by over-stimulation of the plants late in the season. This results in 9- and 10-foot canes which do not mature properly. With Viking it appears to be quite important not to apply fertilizer or manure, other than in early spring or late fall. Be sure to cease cultivation in July and sow a cover crop or allow weeds to grow.

Washington—This is a new quite-late variety from the Western Experiment Station, Washington State. At Vineland it makes good growth with plenty of suckers and so far is free from mosaic. The fruit is of medium size, moderate firmness and good quality, sweet, and of medium red colour. Its value for Ontario is doubtful as it froze back badly in the severe winter of 1942-43 and has been a fairly light cropper.

Willamette—A new variety from Oregon. Fruit long conic, dark red, large, firm, good quality. Mid-season, quite hardy and vigorous. Fruit may be a little too dark for some markets.

THE BLACK RASPBERRY

The black raspberry or black cap (*Rubus occidentalis*) is a native of North America. It is found on the borders of woods from Ontario to the Carolinas but it is not known when it was first brought into cultivation.

Bristol—A strong, tall grower but suffers rather severely from Verticillium Wilt (Blue Stem). It is a good cropper and ripens early, about the same season as Plum Farmer.

Cumberland—Vigorous if free from mosaic. Disease-free stock of this variety may be hard to get. This is probably the best of the old established sorts in its season. Ripens a few days later than Plum Farmer.

Dundee—A good grower and fairly hardy. It seems to withstand virus and Blue Stem fairly well. Yields well. Ripens a few days later than Bristol and Plum Farmer.

Morrison—At Vineland it appears to have considerable merit in its season. It is a vigorous grower, and so far is free from mosaic but takes anthracnose readily. The fruit is quite large and of good quality. A little slow to turn jet black. Yields well, not as many fruits as Bristol but larger, so the total crop would be about the same. Ripens a day or so later than Cuthbert red raspberry.

Naples—Vigorous, fairly hardy and seems to withstand virus diseases and Blue Stem fairly well. Yields well. Ripens about a week later than Bristol and Plum Farmer.

Plum Farmer—Vigorous and hardy. Fruits large and of good quality. Ripens in early mid-season.

Of the above black caps, the newer ones, Bristol, Dundee, Naples and Morrison may, as their merits are established by more extended trial, eventually displace Cumberland and Plum Farmer. They are worthy of extended trial.

THE PURPLE RASPBERRY

The purple raspberry (*R. neglectus*) is a hybrid between black and red raspberries.

Columbian—The old standby in purple varieties but disease-free stock is difficult to obtain. It is a good grower but not any too hardy. Fruit large and of good quality. Ripens late.

Marion—A new purple from the Geneva Station. Vigorous but kills back considerably in some winters and takes Blue Stem rather readily. It is a good cropper, fruits are large, firm, of good quality and fairly acid. Clings rather tightly until properly ripe. Ripens late.

Potomac—A recent introduction from the U.S.D.A. A fair grower. Crops moderately well. Fruit moderate or less in size. Fairly acid flavour. Moderately firm. Needs further trial to establish its value for Ontario.

Sodus—Another new purple from Geneva. A very vigorous grower, kills back rather badly in some winters, and is subject to Blue Stem. A good cropper, the fruit large, firm, fairly acid, ripening several days earlier than Columbian and Marion.

Marion and Sodus are superior to Columbian, although they lack somewhat in hardiness and disease resistance.

THE BLACKBERRY AND RELATED TYPES

The blackberry (often loosely referred to as dewberry, lawtonberry, kittatinny, etc.) although belonging to the same genus as the raspberry, is quite distinct from it, one of the simpler distinctions being the way in which the fruit comes off the fruit stalk. In the raspberry the "core" stays on the plant when the fruit is picked, while in the blackberry it comes off with the fruit. American blackberries are derived from several species of *Rubus*.

Owing to lack of hardiness, to the ravages of the Blackberry Leaf Miner, and to difficulty in controlling Orange Rust, the blackberry is grown commercially in Ontario to only a very limited extent.

B.C. Thornless—This is a fairly vigorous grower and is practically free of thorns. However its fruit is too small for the commercial grower and it is mainly of interest to the plant breeder.

Boysenberry—A new hybrid somewhat of the Loganberry type. It is a vigorous grower and produces long and rather slender fruiting canes which are very prickly. In Ontario it is far from being hardy as much of its fruiting wood freezes back practically every year at Vineland, hence materially reducing the crop. Its fruit is as large as a large Blackberry or Loganberry and is of a deep purple colour when ripe. When really ripe it is a very nice quality being sprightly and moderately acid. However, at this stage it is too soft to ship. At the firm stage or when it is more red than purple it is very acid. For the home garden in the milder parts of Ontario it may have a place.

Eldorado—The variety grown in Ontario under this name is not the same as Eldorado in New York or other Eastern States. However, it is, generally speaking, the most satisfactory kind in commercial production in the Niagara fruit belt. It is a vigorous grower, reasonably hardy for this district, and rarely takes Orange Rust. It yields well and the fruit is large and of good quality. Ripens several days later than the Lowden.

Kittatinny—This name is quite commonly used when speaking of blackberries in general. Actually it is a variety name and should be used only in that sense. At one time this was a very popular variety but owing to its lack of hardiness and its susceptibility to Orange Rust it has lost favour with most growers.

Loganberry—One of the first hybrid brambles. A vigorous grower of long-trailing habit. Not grown in the East on account of lack of hardiness but grown extensively on the Pacific Coast. The fruit is quite large—like a large blackberry—of dull reddish purple colour when ripe. It is of good quality but rather acid.

Lowden—A variety originating at Hamilton, Ontario. It is a vigorous grower and does not seem susceptible to Orange Rust. Also it appears hardier than the Eldorado as grown in Ontario. It yields equally well and ripens several days earlier. The fruit is fairly large, of good quality and has practically no core. It may be noted here that Lowden is apparently identical to Eldorado as grown in the north-eastern States.

Mersereau—Supposed to be a seedling of Snyder. It is more vigorous than that variety and the fruit is much larger and of better quality. It is hardier than the old Kittatinny variety but not equal to Eldorado. As a



Viking red raspberry at Macdonald College, Quebec. This variety seems to be perfectly hardy in Eastern Ontario and Quebec province.

(Courtesy of Professor T. C. Bunting, Macdonald College, Que.)

cropper it is medium to good and the fruit is large and of good quality. The real Mersereau is rather slow in propagation so that true-to-name stock may be scarce.

Youngberry (or Young)—Of vigorous trailing habit but not hardy in Ontario. Grown in the South and on the Pacific Coast.

LOCATION

Raspberries for home use may be grown in almost any location that is not too low and wet or not too much exposed to strong winds. For a successful commercial enterprise however, location is of considerable importance and should be selected with due regard to climatic conditions, labour supply and marketing facilities, etc.

Climatic Conditions—The red raspberry is fairly tolerant of a wide range of climatic conditions. Varieties, however, differ considerably in their climatic preferences; some are adapted to the cool moist climate of the British Isles (Lloyd George), others are better suited to the climate of eastern North America (Cuthbert, Latham, Viking, etc.), while very few or none, thrive in the heat of the Southern States. Two of the most favourable localities for the growth of red raspberries are in certain parts of Scotland and in the Pacific North West, more particularly on the Lower Mainland of British Columbia and in the Puyallup Valley of Washington State. In these districts the climate is usually cool and moist with no great extremes of temperature.

The black raspberry, being a native of the eastern part of North America, thrives in most of the north-eastern states and is grown commercially in Western New York, Northern Ohio and Western Michigan, also to some extent in Ontario.

The purple raspberry, also a native of eastern North America, does not seem to be as hardy as the black although it thrives in the milder sections of Ontario.

The blackberry of various types is fairly widely distributed both in Europe and North America, but practically all varieties under cultivation in Ontario are of American origin; they are not altogether hardy, however, and also may suffer from drought.

Labour Supply—The usual operations of growing raspberries such as cultivating, pruning, etc., do not call for any great amount of extra labour, but the picking does require extra help and provision must be made for securing it when needed. If it is impossible to get this extra help it is not advisable to go into raspberry growing on an extensive scale. It is not necessary, though, to be near a village or town, as many growers make provision for housing families of Indians and others for the busy season. These people as a rule make good pickers, especially the women and children.

Marketing Facilities—The importance of good marketing facilities for such a tender fruit as the raspberry cannot be over-estimated. While some of the newer varieties are very firm and stand up very well relatively, yet even the best of them deteriorate rapidly after picking and so must be marketed promptly and with a minimum of handling. A grower who has to haul his raspberries a long distance will be seriously handicapped in growing this fruit at a profit.

Market Preferences—These vary with proximity to fresh fruit markets and to processing plants. The demand by the fresh fruit trade is for a bright, attractive berry that does not readily become dull or stale in appearance, and on the other hand the demand of the processors is for a berry that will have a good, rich appearance and hold together well when canned or frozen.

SITE

The actual site for a raspberry plantation must be chosen with care, considering especially natural drainage, moisture supply and winter injury. Also, it should be remembered that a warm southern slope tends to promote earliness of ripening whereas a northern slope tends to lateness, and too, the effects of drought may be more pronounced on a southern than on a northern slope.

Natural Drainage—Raspberries must be grown on land that is naturally well drained. Ditches and tile drains may do much to improve drainage, but if land is naturally poorly drained it is not desirable for raspberry growing. Low wet pockets especially should be avoided as water is apt to accumulate in them and it is decidedly harmful to have the soil in a water-logged condition for any length of time. Rolling high land is usually well drained, but if too high and steep it is apt to be dry and perhaps unfertile and the slopes are likely to "wash" badly under cultivation.

A study made in 1935, of about two dozen raspberry plantations in the Niagara fruit district, indicates very definitely that good natural soil drainage is one of the main factors in the successful growing of raspberries.



Winter injury in red raspberry. Note that canes are leafing only at base.
Upper parts are dead.

Moisture Supply—Although raspberries need good drainage, they also need a good supply of moisture, especially during fruiting, a time when moisture may be deficient through drought and intense heat.

The moisture supply can be regulated to some extent by suitable cultural methods. Keep up the organic matter supply of the soil by growing a cover crop after picking. Prior to picking, control the weeds to prevent competition for moisture. Thin out the rows so that the canes are about 6 inches apart.

Irrigation is of undoubted value in a raspberry patch in such seasons as we experienced in 1949. Growers who have a supply of water either from a lake, stream or farm pond, would do well to investigate the newer types of light-weight portable irrigation systems. It is a very rare season indeed in which some crop, sometime, wouldn't benefit from irrigation.

Winter Injury—Slight killing back of canes is not serious but when canes are badly injured the crop may be much reduced.

The actual causes of injury are not any too clear. Contributing factors, however, are lack of cane maturity induced by a late growing season, with too much moisture in the soil, followed by severe cold, also lack of snow cover during the winter and strong freezing winds sweeping

*With the ruthless destruction of natural bush it is becoming more difficult from year to year to find wind protection for farm crops. To counteract this, shelter belts of trees should be planted. (Trees for this purpose may be obtained from the Provincial Department of Forestry.)

through the plantation, and to a lack of hardiness in a variety. Hence by correcting these conditions winter injury should be appreciably lessened. Appropriate means to this end would seem to be proper attention to drainage, growing of cover crops between the rows in the fall, choosing a site that is protected to some extent from prevailing winds*, particularly west winds, and planting varieties that are hardy for the location.

These remarks on location and site for the red raspberry apply also to the black and purple raspberries and to the blackberry.

SOILS

Raspberries and blackberries require a soil that is well drained and yet holds plenty of moisture. This condition is best found in a deep, sandy loam soil that is well supplied with humus. A deep soil tends to encourage deep rooting which would help to lessen the injurious effects of drought while a shallow soil, especially if underlaid with a "plow sole" or with hardpan, will tend to cause shallow rooting and consequent injury from drought. A coarse, gravelly soil is very undesirable as it allows water to run away too freely and undoubtedly will be lacking in fertility.

SOIL PREPARATION AND FERTILIZATION

As raspberries and blackberries are comparatively permanent crops the preparation of the soil before planting is of considerable importance. Perennial weeds such as Canada Thistle and Quack Grass must be eliminated. If the soil is not naturally well supplied with humus or organic matter it will be necessary to start building it up for a year or two previous to planting. Farmyard manure may be applied in liberal quantities for other crops that may be grown on the land previous to setting out the raspberries. Twenty to thirty tons per acre would not be too much to use in this way. If sufficient manure is not available at a reasonable price it should be supplemented by plowing under green manuring crops. Hay or straw also may be used for this purpose.

There are various crops that may be grown for green manuring, including buckwheat, rye, oats, corn, alfalfa, sweet clover, red clover, etc.

A legume, such as alfalfa or one of the clovers, will help to increase the nitrogen supply as plants of this class have the ability to take up atmospheric nitrogen by means of micro-organisms in their root nodules.

To facilitate rotting of organic matter in the soil, various micro-organisms must come into action. This activity calls for a supply of nitrogen which will have to come from the soil solution. Hence, it will be advisable to apply a light dressing of a nitrogen fertilizer (ammonium nitrate, ammonium sulphate, or cyanamid) just as the green crop or other plant material is being plowed under. In the case of legumes the extra nitrogen will not be required.

Soils vary greatly in the supply of available food material they contain and so the kinds and quantities of fertilizers to use can be stated only in a general way.

The Ontario Advisory Fertilizer Board has drawn up recommendations which are intended as a guide under average conditions. These recommendations are given in the next few paragraphs—

Year previous to planting—

Either 20 tons of manure per acre in spring

or 6 tons of hay or straw* plus 300 lbs. of nitrate of soda or equivalent, with another 300 lbs. in the fall

also 400 lbs. superphosphate and 200 lbs. potash or 600 lbs. 0-12-20. In either case use with green-manure crop.

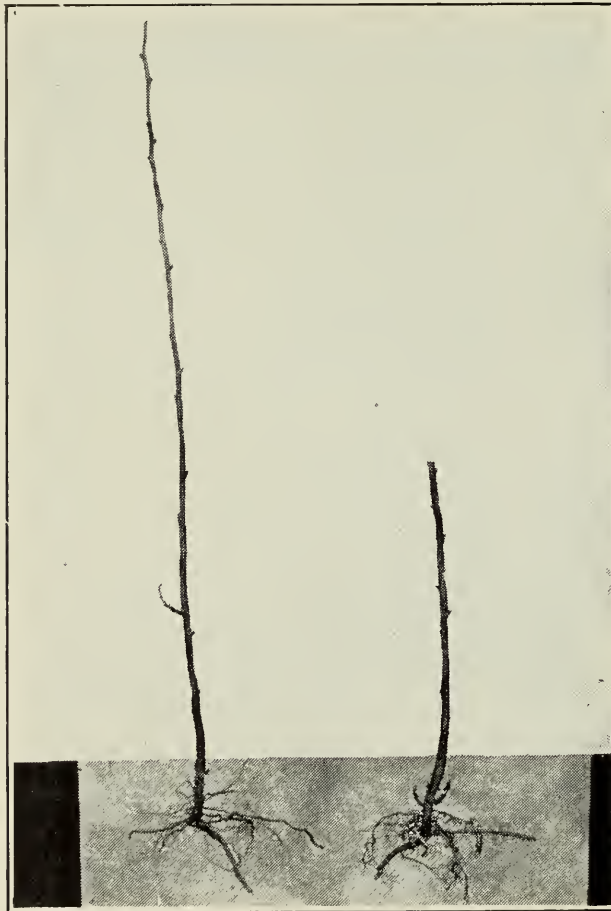
After planting—

Either 10 tons of manure annually

or 3 tons of hay or straw* annually in fall plus 150 lbs. nitrate of soda or equivalent, with another 150 lbs. in the spring.

also in the spring 500-700 lbs. 5-10-13.

*If legume materials are used the nitrogen supplement is unnecessary.



Mature cane plants for planting. Cane on right cut back at planting time.

PLANTING

Time of Planting—The majority of growers favour planting in the fall. By planting at this time of year the plants are in the ground ready to start growth in the spring as soon as conditions are favourable. Spring planting also has its advocates and if spring suckers are to be used the planting cannot well be done at any other time. Some growers prefer planting in the fall simply because they seem to have more time then. Black and purple raspberries and blackberries are best planted in the spring.

Type of Plant to Use—Most growers prefer the mature sucker canes to the new spring suckers. Generally the former are more satisfactory especially if they have to be brought in from a distance; another advantage is that they can be planted either in the fall or spring. Spring suckers, however, may be used with success.

Black and purple raspberries do not throw up suckers, but the ends of the branches which bend down to the ground take root and it is these rooted ends or “tips” that are used. To facilitate the rooting of these “tips” the longer canes are bent down and the ends held in place by



Spring sucker plants. A. Good type to use for planting although smaller plants could be used to advantage. B. Poor type; sparse root and no underground stem.

covering them with a little earth. This is usually done in late summer when the ends of the canes lengthen in “snaky” or “rat tail” fashion. These covered ends have rooted usually by late fall and in the spring they may be dug up and cut free from the mother plant with about a foot of cane attached. Larger quantities of “tips” may be obtained from a plant by pinching back the main shoots in early summer which will induce the formation of laterals. These laterals will usually make enough growth by early fall to permit of them being “tipped”.

Healthy plants only should be used for planting a new plantation as the success of the grower depends very much on using only disease-free stock. Virus diseases (mosaic and curl leaf), anthracnose and crown gall may cause serious loss.

Certified Plants—Those who are interested in getting disease-free plants are advised to apply to the Dominion Laboratory of Plant Pathology at St. Catharines, Ontario, for a list of nurseries and growers who have certified plants for sale. These plants are from plantations that have been inspected for virus diseases and are certified as being free of these diseases.

Systems of Planting—Red raspberries are usually grown by the “hedgerow” system, that is, the plants are allowed to spread along the row, no attempt being made to keep individual plants separate. Some growers prefer the “hill” system. This term would seem to have two interpretations. In one it means that the plants may be set in rows eight or nine feet apart and about three feet in the row and the plants kept more or less apart by removing the suckers between them. In the other it means that the plants may be set on the square, five or six feet both ways. This latter system would permit of cross cultivation which would lessen hand hoeing and it would seem that individual plants would have a better chance to develop owing to more even distribution of light, air and rooting space. To get as many plants to the acre, however, as by the common eight feet by two feet distance of the ordinary “hedgerow” system, the plants would have to be set four feet by four feet which will be a little too close. Cultivation in both directions offers no advantage if the plantation is comparatively long and narrow as the extra turning with a horse cultivator will offset the saving in hand hoeing. It is quite probable that at the greater distances the individual plants would yield better than those that were grown in rows, but it is a question whether the yield per acre would be as great.

Distances of Planting—With any of these fruits the distance between the rows varies from five or six feet up to twelve feet. The former distance is rather close except for a small garden plantation and the latter seems unnecessarily far. Eight or nine feet is a good distance for the commercial plantation.

Distances of plants in the row run from one and a half feet to three feet for red raspberries, while black and purple raspberries and the varieties of blackberries that are grown in the East may be set from two to four feet apart depending on the vigour of the variety.

Marking the Land and Planting—In the row system of planting it is not necessary to do much marking out. All that is needed is to mark the distance between the rows with a few stakes. Furrows are then plowed in line with these at the required depth; it is not necessary to mark the distance apart for the plants in the rows. If the square “hill” system is to be followed it will be necessary to mark the land in both directions as the rows must be straight both ways to facilitate cross cultivation. The red raspberry should be planted about four or five inches deep, but the black and purple varieties should not be set too deep at first or the “tips” may be smothered. A good way is to cover them with an inch or two of soil when planting and to increase it gradually as the shoots grow so that the plants are finally covered with four or five inches of soil. Blackberries may be set in a similar way to the red raspberries.

Raspberry plants should not be allowed to become dry through exposure to sun and wind. Also, when firming the soil about the roots particular care must be taken not to injure the young growing shoots.

CULTIVATION

Cultivation should be started reasonably early in the raspberry patch to encourage early growth of new canes. This allows the canes more time to mature and harden off before winter. Since weeds compete with the crop for water and nutrients they should be controlled up to picking time. Do not cultivate more than necessary to control weeds. Occasionally it may be necessary to cultivate after heavy rains to prevent the soil crusting or cracking even if no weeds are present.

Many of the feeding roots are quite near the surface so that cultivation should always be quite shallow. It may be desirable to shorten the cultivator teeth next to the plants. Heavy tractor disks should be used with care.

Late growth will be stimulated by late cultivation, so that the canes will not mature properly and winter injury may occur. This is especially true with the Viking variety. For this reason do not cultivate later than immediately after picking time. It may be necessary to suspend cultivation during picking time to avoid knocking off ripe fruit. As soon as picking is finished a cover crop should be sown or else the weeds should be allowed to grow. The cover crop or weeds will compete with the raspberries for water and nutrients with the result that the canes will mature earlier and not be so susceptible to winter injury. The cover crop should be left over winter to help check wind and water erosion. It will also hold snow which in turn will help protect the canes. In the spring, when the cover crop is worked down, it will add organic matter to the soil.

Various cover crops such as oats, barley, rye, millet, and buckwheat may be used for cover crops. All these crops, except the rye, die before spring. Rye should not be allowed to grow too much in the spring because it will take too much moisture from the ground; also if it becomes woody and tough it will decay too slowly and will rob the raspberries of needed nitrogen.

As previously noted, when plowing down fairly heavy crop residues it is advisable to apply a nitrogen fertilizer such as ammonium nitrate, ammonium sulphate, or cyanamid, to help the micro-organisms in rotting this material. This is, of course, unnecessary for legume residues.

The practice of plowing up to the canes in the fall and away in the spring is one of questionable merit. Fall plowing leaves the ground bare all winter and much erosion can take place especially on sloping ground. Much injury to roots can occur unless the plowing is very shallow next to the rows. It is true that a furrow thrown into the row in fall may serve to give some protection to the crowns. Actually it may be desirable to plow one or two furrows in towards fall-set canes the first fall, to reduce heaving. Plowing in successive falls however, is to be discouraged. If necessary for drainage a single furrow can be run down the centres between some or all of the rows.

Weeds in the raspberry row should be forked out rather than hoed out. A hoe may cause much damage to new suckers just coming through.



Blackberries when properly pruned do not need trellising.
(*Plantation of Donald Jory, Beamsville*)

MULCHING

There is some evidence to show that under some conditions mulching with straw or peat or similar material, between the rows of raspberries may be a good practice. The chief advantages claimed for mulching are—conservation of moisture with cooler soil, elimination of cultivation and prevention of soil erosion, which are very much worth while. Against these advantages, however, must be set the cost of mulching material and the labour of application; the difficulty of obtaining sufficient suitable material free from weed seeds; some delay in ripening of fruit in a wet season and probable delay in maturing the wood in the fall. Also, it is questionable whether a mulch, unless very heavy, will actually smother all weeds and suckers between the rows. And, too, with the mulch continually breaking down it would need to be added to from year to year. Another point to consider is the fact that a mulch tends to induce many roots to form near the soil surface and so considerable damage would result if for any reason it became necessary to plow the plantation. Fire hazard also must be considered where hay or straw are used.

Mulching for raspberries is still in the experimental stage but it is worthy of serious consideration, at least for a home garden planting, or in an experimental way.

PRUNING

The pruning of each type of raspberry and the blackberry is generally similar but with modifications due to the habit of growth of each. Canes are formed one year which produce fruiting shoots the next. After

fruiting these canes are of no more use and so should be removed. They are usually cut out just after picking, although some growers prefer to leave them in until the next spring, thinking that they help to protect the new canes from wind injury. For the same reason some do not thin out surplus young canes of the red raspberry until spring. In thinning surplus canes all the weak ones should be removed, leaving only enough strong ones so that they are about six inches apart. These should be spaced as evenly as possible over the width of the row, which may be from twelve to eighteen inches. If this is done just after fruiting it is as well to leave a few more than are actually required in case of accident or loss from winter injury. These surplus canes may be removed in the spring when those to be left are headed back. This heading back is usually deferred until the extent of winter injury can be determined.

The old recommendation among growers was to cut canes off at "hip-height". This probably would be about right with some varieties that did not grow overly tall and in certain seasons when growth was not very strong, but it would seem that this might be too severe with strong, tall canes. There is some evidence both from experimental work and from growers' experience which indicates that the crop may be considerably reduced by cutting back the canes too much; in fact, in several experiments the greatest quantity of fruit has been obtained from canes that were not cut back at all. One of these experiments conducted at the Central Experimental Farm at Ottawa with the Herbert variety gave results in favour of no cutting back. Canes that were cut back yielded at the rate of 3,772 boxes per acre while those that were not cut back yielded at the rate of 5,274 boxes per acre. An experiment at the Ontario Horticultural Experiment Station, which was carried on several years ago, using the Cuthbert variety, gave similar results. It was noted, however, that although the unpruned canes gave a greater total number of fruits than the pruned, yet in the latter there was a greater proportion of good marketable berries. Where pruning was more severe the crop was considerably reduced although practically all the berries were of good size. When soil moisture is seriously reduced by drought, canes that are headed back are more likely to develop and ripen their fruit than those that are not headed back as there is not enough moisture for a full crop.

Apart altogether from its effect on yield, some cutting back of the canes is desirable as it results in stockier plants which are not so subject to wind injury and which will remain upright under a load of fruit. Canes that bend over to the ground will not carry their load of fruit to advantage.

Probably it is better to say that a certain **proportion** of cane should be cut away rather than that the cane should be cut to a certain height irrespective of the amount of growth. From observation it would seem that one-third would be about the right amount to remove.

Summer Tipping—Summer "tipping" of the new canes is practised by a few growers who claim that it produces stockier plants. The majority, however, do not see any particular advantage in the practice and find that the new side growths or laterals that come from the "tipped" cane



Cuthbert raspberry before pruning.



Cuthbert raspberry after pruning.



Newburgh raspberry before pruning. Note branching habit.



Newburgh raspberry after pruning.

are more subject to winter injury than the original cane. This was found to be the case in an experiment carried on for several years at this Station.

In the black and purple raspberries and the blackberry, the young canes are pinched back when they are two to three feet high. The laterals that are forced into growth usually ripen sufficiently so that they are not winter killed except sometimes in the case of the blackberry, which is the most tender of the "bramble" fruits usually grown in Ontario. These laterals may grow from twelve to thirty inches or more in length and the usual practice is to shorten them considerably in the spring. In the black and purple raspberries eight or ten buds per lateral is enough to leave, while in the blackberry it depends somewhat on the fruiting habit of the variety. Some varieties produce fruiting wood nearer the main stem than others, but at least half of each lateral may be removed. With this system of pruning no trellising is required as the plants are low and stocky.

In a newly set plantation of any of these fruits the only pruning required is the initial shortening of the canes when planted; these canes may be shortened to about a foot.

Trellising—With the system of heading back of raspberries and blackberries, trellising usually is not necessary. Some growers, however, find with varieties that are apt to bend over with the weight of fruit that a simple trellis prevents considerable loss of fruit. A single wire stretched along each side of the rows supported by posts or pickets is all that is needed.

PLANTATION RENEWAL

Plantations of "bramble" fruits are less permanent now than formerly. Years ago it was not uncommon for a plantation to remain profitable for fifteen or twenty years, but now owing principally to the prevalence of virus diseases and winter injury about one-half that time or less would seem to be the limit; in fact, some growers consider that six years is about the profitable life of a plantation. Under favourable conditions of soil with freedom from winter injury and disease it is quite possible to keep a plantation in profitable condition for considerably more than six crop years, but as a general rule it would seem better to take off six good crops and then discard it. Hence frequent renewal becomes a necessity.

PICKING

Picking—The necessity of being able to secure sufficient help for picking has been spoken of under the section "Location and Site". Having the necessary help on hand, the grower must have everything organized so that picking can begin just as soon as enough berries are ready and continue smoothly until the picking season is over. He must have a supply of berry boxes, the pint size for preference, also carriers for use in the field and crates for shipping. As pickers are usually paid piece work, some means must be provided for keeping track of the quantity each person picks; this is often done by means of tally cards on which the quantities are marked by the person in charge.

The supervision of pickers is of great importance. They must be instructed to place the berries carefully in the boxes and not to drop them in and they should not be allowed to hold too many in their hands at once. Also, berries must be picked at the proper stage of ripeness. Berries that may be termed "soft" ripe are too mature for shipping and so must be picked while still quite firm, though well coloured. Also, pickers must be urged to pick clean as they go, because berries that are ready to pick at one picking will certainly be too ripe at the next.

YIELDS AND COSTS

Raspberry yields and cost of production vary considerably with the grower, soil and weather conditions. Early records (1910) state that an average yield in Ontario of 4,450 pints per acre was obtained on 68½ acres, while in New York State yields ran from 3,200 pints to twice that amount. Good growers in Ontario used to figure on getting from 4,000 to 5,000 pints per acre. (Yields for black raspberries are reported to be somewhat higher than for reds provided the plants are free from mosaic diseases.)

A recent field study made in Michigan (Circular 203, June, 1945) gives some interesting data on yields and costs for production of black and red raspberries. Yields on 70 plantations ranged from 438 pints* to 3,000 pints per acre including both reds and blacks. This great range is attributed to differences in soil, site and management practices on the part of the growers. Total costs on the highest yielding plantations were \$269.51 and those on the lowest yielding were \$108.37 per acre.

Cost per pint on the highest-yielding plantations was slightly over 11 cents, while for the lowest-yielding plantations it was 15 cents. Most of the lower cost was due to lower costs of growing as the overhead and harvesting charges were about the same on high-yielding and on low-yielding plantations.

It is of interest to note how the cost figures per acre (1943) for the 70 raspberry plantations are apportioned to overhead, growing, harvesting and marketing.

	Costs per acre	Costs per pint 1615.5 pts. per acre
Overhead	\$ 60.35	3.6 cents
Growing	61.96	3.8 cents
Harvesting and Marketing	78.80	4.86 cents
	\$201.11	12.4 cents

No statement can be made as to profits as these depend on the margin between costs and prices obtained.

*In the Michigan bulletin yields are give in pounds, which have been converted into pints on the basis of 1 lb. being equal to 1½ pints. This for more ready comparison with other yield figures. At the Horticultural Experiment Station, Vineland, the weight per pint varied considerably but averaged about ¾ pounds.

INSECTS ATTACKING RASPBERRIES AND BLACKBERRIES

By H. W. Goble, B.S.A., M.S., Department of Entomology, O.A.C., Guelph

Although insects occasionally cause serious loss to raspberries in Ontario, it has not been found necessary to apply dusts or sprays for them every year or in all plantations. Good cultural practice may be all that is necessary. Growers are advised to watch their plantings carefully and apply treatment promptly when required.

The chief insects attacking raspberries are tree crickets, raspberry saw-fly, raspberry fruitworm, raspberry cane borer, red-necked cane borer, rose stem girdler, raspberry root borer, two-spotted mite (red spider), and the blackberry leaf miner. Also strawberry leaf beetles, cutworms and white grubs may occasionally cause damage.

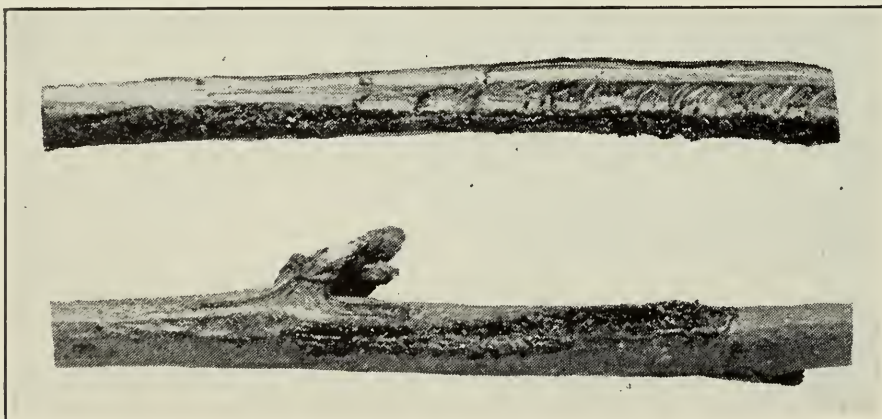
GENERAL CONTROL PRACTICES

Good cultural practices are very important in insect control on raspberries and blackberries. In the spring prune out and burn canes or portions of canes showing swellings, scars or cracks. Prune out and burn canes that leaf out poorly as these may contain borer larvae in the lower parts. As soon as possible after picking remove and burn old canes and surplus new canes. When an old or unproductive planting is ploughed up, gather and burn as many of the canes and roots as possible as they may contain insects.

TREE CRICKETS

Oecanthus spp.

These are white or greenish-white crickets about three-quarters of an inch long and are more slender than the ordinary black field cricket. They are often called snowy tree crickets. Injury is caused by their habit of laying eggs in the canes in late summer and autumn. The eggs are



Tree cricket egg scars; one cane split open to show the eggs.

(Courtesy of W. A. Ross)

inserted deeply into the canes in longitudinal rows which are from 1 to 4 inches in length. Small brown scars on the surface of the cane indicate their presence. Later on, the part of the plant above the scar dies. Egg scars may be found near the ground to within a foot of the tip of the cane. The eggs do not hatch until some time in June.

Control—(1) Cut and burn in late fall or early spring all stout weeds and wild raspberries near the plantation, as eggs are laid also in these. (2) When pruning and thinning watch for egg scars and either remove the affected canes or cut them off below the scars. A second inspection in early June will, by the presence of dead tops, make it easier to find and destroy many infested canes that have been overlooked. All prunings should of course be burned. (3) Where it has not been possible to remove practically all the scarred wood, spray the plants well with $3\frac{3}{4}$ pounds arsenate of lead and 10 pounds hydrated lime to 100 gallons of water just before bloom. Then, as soon as the crop is harvested, remove all the old canes and burn them, and spray the remainder with the same mixture. The poison kills most of the young and adult crickets. (The lead arsenate may be used with Bordeaux 5-5-100. See the Ontario Protection Calendar for Small Fruits, for combination.)



Raspberry saw-fly larvae and their work.
(Courtesy of W. A. Ross)

RASPBERRY SAW-FLY (*Blennocampa rubi* Harris)

The larvae of this saw-fly are little spiny caterpillars about two-thirds of an inch long when full-grown and of almost the same colour as the leaves. The colour makes it difficult to detect them unless numerous. The larvae attack raspberry plants in late May and early June and eat numerous holes in the leaves. At times they are so abundant that they devour all the foliage except the midrib and larger veins. In such cases the crop, of course, is ruined.

Control—They are not difficult to control, but great care must be taken to examine the foliage the latter part of May and early June, otherwise the damage may be done before the owner is aware of what is happening. As soon as injury is seen, spray at once with 2½ pounds arsenate of lead and 10 pounds hydrated lime to 100 gallons water. Use a fine mist spray and try to cover all the leaves. A dust of 1 part arsenate of lead to 4 parts of hydrated lime, gypsum, or talc may be used instead of the spray, but will not stick so well in wet weather.

Caution: The spray must be on before the blooms are open otherwise there is danger of poisoning bees and human beings. If the infestation is not noticed until after the fruit is set commercial pyrethrum or derris (rotenone) sprays or dusts should be applied according to the manufacturer's directions.

RASPBERRY FRUITWORM

(*Byturus rubi* Barber)

The adult of this insect is a small brown beetle about one-seventh of an inch long. The larva is a small white grub or "worm" about one-quarter of an inch long. If present in a raspberry patch, two types of injury may be seen. The adults feed in the spring on the flower bud clusters and on the opening leaves before bloom. The larva feeds as a small white grub-like form in the base of the cup of the berry. If present, they will be found in the berries at picking time. During the last few years their presence has been reported frequently in home garden plantings.

Control—If this insect has caused loss in previous years or if the beetles are seen in numbers on the flower bud clusters, it is advised that the patch be sprayed. Either lead arsenate or derris (rotenone) may be used. Apply when the beetles are seen in the bud clusters. Use 5 pounds lead arsenate in Bordeaux 5-5-100 or use 5 pounds lead arsenate and 10 pounds hydrated lime in 100 gallons water. If derris is preferred use 5 pounds derris (4 to 5 per cent rotenone) plus a commercial spreader, to 100 gallons of water. Drive the spray into the opening buds and leaves using good pressure.

A one per cent rotenone dust may also be satisfactory if thoroughly applied.

RASPBERRY CANE BORER

(*Oberea bimaculata* Oliv.)

The adult of this insect is a slender, cylindrical, long-horned beetle about one-half inch in length. It has a black body and yellow neck. The beetles appear in June and have the peculiar habit of cutting two rings around the stem about half an inch apart, from 4 to 8 inches below the tip of the shoot. An egg is laid in the tissue between the rings. Soon after the girdling the part above wilts, droops and dies. The egg hatches into a yellowish grub which bores a short distance down the stem and winters there. Next year it bores on down to the root and kills the plant. Most years only a few plants are attacked, but sometimes the number is large.

Control—All that is necessary is to inspect the plants once every week or ten days in June, and cut off the wilting tips about 2 inches below the girdled area. This removes the eggs or grubs before any harm worth mentioning is done.



Cane girdled by the raspberry cane borer.
(Courtesy of W. A. Ross)

RED-NECKED CANE BORER (*Agrilus ruficollis* Fab.)

This insect in the adult stage is a small, slender beetle about one-third of an inch long. The body is black and the neck coppery-red. The beetles feed upon the foliage but seldom, if ever, do any appreciable injury. All the important damage is done by the larvae which, in late summer and autumn, work in the canes making spiral tunnels around them a little distance below the bark. This causes the affected parts of the canes to swell, producing what some growers call "Gouty Galls". The swollen areas vary in length from 1 to 2 inches and are about half as large again in diameter as the cane itself. Often the bark on these swollen places splits open. The part of the plant above the swelling usually dies the next spring. The insect, though present almost everywhere, is very scarce in most plantations, but in some is abundant enough to cause the destruction of many plants.

Control—(1) As the insect feeds and breeds also on wild raspberries and blackberries these should be cut out in late fall or early spring and

burned. (2) When removing old canes after the crop is off, and again when thinning out superfluous wood in the spring, watch for affected canes and remove them. These steps will lessen greatly the number of adults which will emerge. (3) As adults feed upon the foliage, spraying with lead arsenate at the same times and rate as given for tree crickets will reduce injury. The lead arsenate may be combined with Bordeaux 5-5-100 as given under tree crickets.

ROSE STEM GIRDLER

(*Agrilus communis* var. *rubicola* Abeille)

In addition to the red-necked cane borer, raspberry canes are sometimes attacked by the rose stem girdler, although this insect occurs more frequently on currants. The injury is caused by the larvae tunnelling in the canes and girdling them so that the shoot above the point of attack is killed. In addition to raspberries, it attacks currants and gooseberries, and also roses.

Control—Control measures given for red-necked cane borer are effective against this insect also.

RASPBERRY ROOT BORER

(*Bembecia marginata* Harris)

This whitish to yellowish borer, which is about 1 inch long when full-grown, works in the larger roots of both raspberries and blackberries and either kills or weakens the plants. It is probably present in most old plantations which have been more or less neglected. In vigorous well-cared-for plots it seems to be very scarce.

Control—There is no direct control for this pest. The best plan, when a plantation becomes old and is found to have many root borers present, is to plow it up in late September or October after all eggs have been laid by the moths, and then gather and burn all the larger roots. In home plantings, if there are indications of boring in the crowns, probe with a wire or sharp knife to kill any larvae present. The eradication of wild and uncared for raspberries and blackberries is also advised.

TWO-SPOTTED MITE (Red Spider)

(*Tetranychus bimaculatus* Harvey)

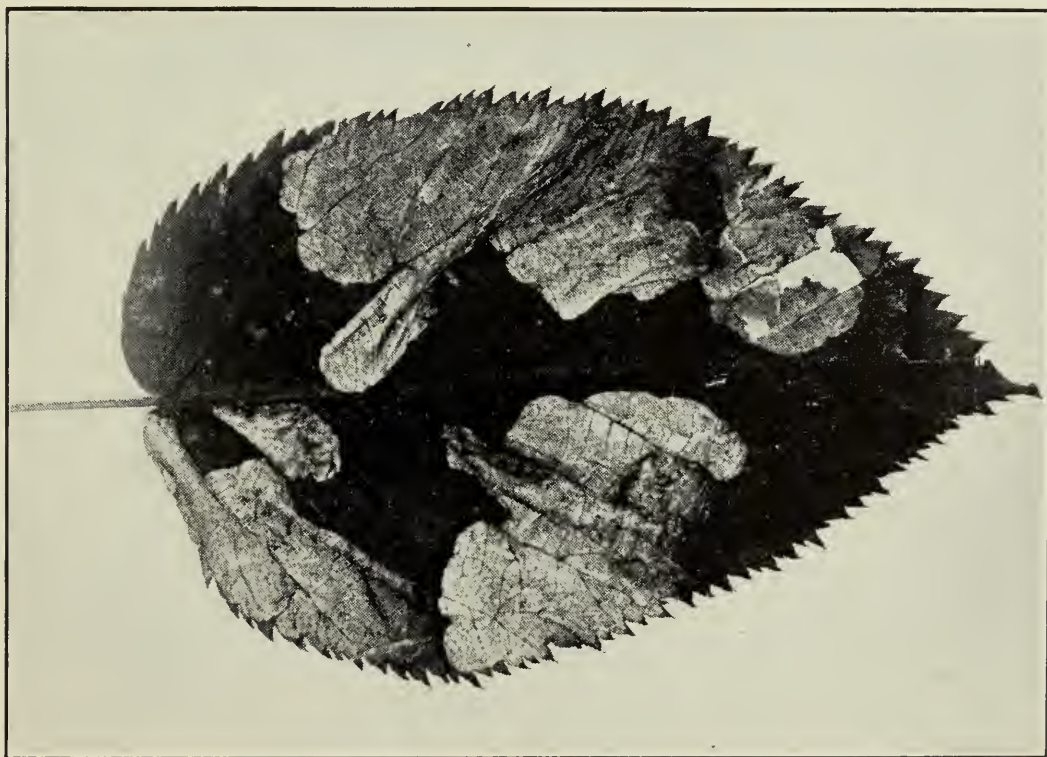
This destructive pest of raspberries is the same red spider which attacks and often injures severely greenhouse plants. It is common also, on many outdoor plants, for instance phlox, sweet peas and currants. It is a tiny mite just large enough to be seen by the unaided eye. Its colour, except in autumn, is seldom red, but usually a pale greenish yellow. The mites work on the under side of the leaves and are more or less protected there by a very light, fine silken web. Here they suck the juice out of the foliage and when very abundant cause it to become strikingly pale and sickly in colour. They are most numerous and destructive in dry seasons. There are several broods a year. The winter is passed as adults chiefly in the ground or beneath rubbish.

Control—Spraying with a 1 percent summer oil emulsion plus 2½ pounds of soap per 100 gallons of water is recommended. As the mites are on the undersides of the leaves, spray from underneath very thorough-

ly. Spraying with an oil, however, must not be done when the plants have been seriously injured by the mites, or in very hot weather, as under either condition the oil is liable to damage the foliage. Do not combine the oil with Bordeaux recommended for disease control even though the time of application may be the same, as it will not give effective kill of mites when combined. Since growers seldom observe mite infestations until it is too late to apply control, the safest policy is to examine the undersides of the older leaves in late May and if mites are readily found or if these leaves show any greying from mite feeding, spray the patch at once. Raspberry plantations which are known to be subject to mite injury should be sprayed in late May every year.

There may be other chemicals that are satisfactory for mite control. Further experimental work is required with these before recommendations are made.

N.B.—Only oil sprays specially made for summer spraying should be used for mite control. These are available from various oil companies or from companies handling insecticides. The type of oil and method of preparing an emulsion are given on the Ontario Protection Calendar for Small Fruits.



Work of blackberry leaf miner in leaf of blackberry. The mines in nature are brown, not grayish as shown here.

BLACKBERRY LEAF MINER (*Metallus rubi* Forbes)

This insect is the larva of a small black four-winged fly known as a saw-fly. The flies lay their eggs in the foliage of blackberries in June and early July and the little greyish-white larvae from these form mines in the leaves by feeding on the tissues between the upper and lower surfaces. They are sometimes so numerous that by the end of July almost every leaf is killed and drops off. In August new leaves have taken their place, but

these too become attacked by a second brood and are often severely injured before winter. Such injury to the leaves weakens the plants greatly and lessens the crop or almost destroys it. Fortunately there have been very few of these insects the last 15 years, though for several years previously they were very numerous in some localities. The winter is passed as larvae in the soil in small oval cases which are not injured by cultivation.

Control—Many attempts have been made to find a control, but all have failed. Fortunately parasites are very numerous and the present scarcity of the insect appears to be attributable to them.

Acknowledgement

The co-operation and assistance of the Dominion Entomology Laboratory at Vineland Station is appreciated in preparing the section on insect control.

RASPBERRY AND BLACKBERRY DISEASES

J. D. MacLachlan, B.A., A.M., Ph.D., Department of Botany, O.A.C., Guelph

There are several troublesome diseases of raspberries and blackberries but good growers have found that the following cultural practices are sufficient to keep most of these diseases under control. Additional special practices for disease control are given along with the descriptions of the various diseases. Winter injury, a common trouble in plantations, is described on page 14. Growers should also obtain the Ontario Protection Calendar for Small Fruits. This calendar is revised each year and gives the latest control measures for both diseases and insect pests. It is available at the office of the local agricultural representative.

CULTURAL PRACTICES FOR DISEASE CONTROL

Secure planting stock free from disease, either by careful selection or by the use of certified plants. Certified stock is inspected annually and is accepted for certification only if it is satisfactorily free of disease, of good general vigour and not mixed varieties. Copies of the list of growers of certified stock in Ontario are made available each year and may be secured on request from the Dominion Laboratory of Plant Pathology, St. Catharines, Ontario.

Where possible, new plantings should be at least 500 feet from old fruiting plantations or clumps of wild raspberries. This will help to prevent the spread of disease, particularly viruses, to new plantings.

Several of the diseases are favoured by moist conditions around the canes. Select sites with good natural soil drainage, space the rows at least eight feet apart, and practise clean cultivation to keep the weeds down.

Certain of the diseases are carried over from season to season on the old canes. Prune out and destroy all old canes. Leave only healthy vigorous, new canes and then only sufficient for the next year's crop.

It is desirable to renew plantations frequently. The practice of planting part of the available acreage in successive years is recommended.

In this way it is possible to discard older plantings when diseases, particularly the virus diseases, become of sufficient importance to cause reduced yields.

VIRUS DISEASES

A virus is not a bacterium or a fungus but a minute entity which is capable of multiplying and causing disease. It is often referred to as an "infective principle".

Virus diseases are the most important troubles affecting raspberries in Ontario. They result in weakened plants with poor fruit yield and have been referred to as the cause of the so-called "running-out" of raspberry plantations.

A virus-infected raspberry plant never recovers and it serves as a source of infection for healthy plants in the plantation. The spread from plant to plant is slow but sure. Raspberry aphids, by feeding on diseased plants, become contaminated with the virus and carry it to healthy plants.

MOSAIC DISEASES

(Caused by viruses)

There are several virus diseases of raspberries referred to as Mosaic, but from the grower's point of view they can all be treated as one. The Mosaics are the most common of virus troubles on raspberries.

Leaf Symptoms—The name "Mosaic" refers to the effect of the virus on the leaves. The leaves become mottled, that is, pale green to yellow areas or blotches develop on the leaf surface. The mottling may be fine or coarse and sometimes it is in definite ring patterns. Commonly the mottling is present on all the leaves of an infected plant, but in one type of Mosaic it is usually confined to the lower leaves. Frequently the leaves show a puckering of the surface and a tendency to be narrower and to cup downwards. By casting a shadow on the leaves, the Mosaics are often more readily seen. Some types of Mosaic on raspberry leaves are illustrated on page 34.

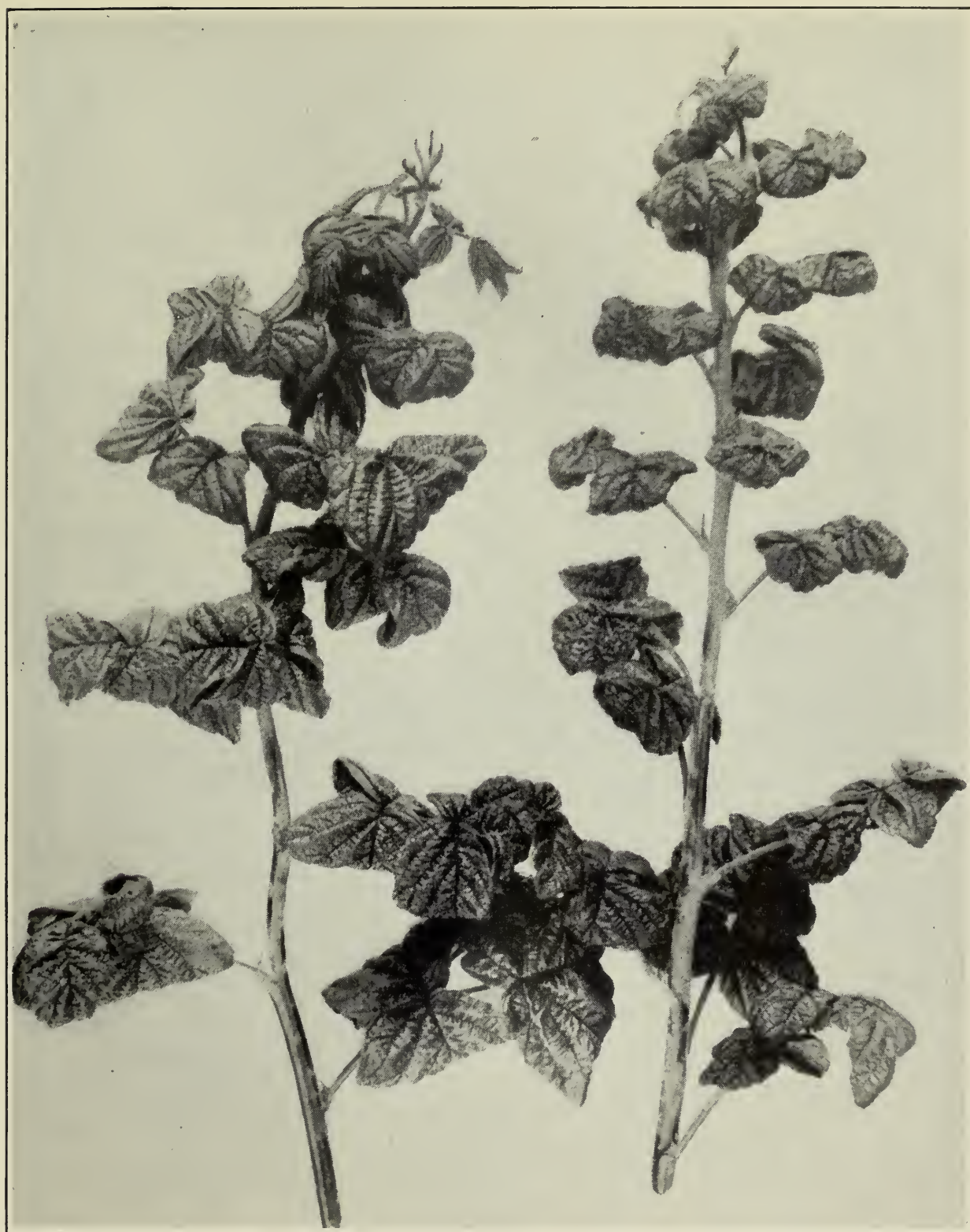
Plants affected by Mosaic are most readily seen in June when growth is vigorous. Later the mottling may be masked by high temperature, heavy red-spider infestation, or even confused with mottling resulting from powdery mildew infection. The powdery mildew may be distinguished from Mosaic by the presence of the white fungus growth on the underside of the leaf and by the fact that only the younger leaves show the mottle. Off-colour foliage, the result of poor soil or lack of drainage, should not be mistaken by growers for Mosaic symptoms. In this case the paling or yellowing of the leaves is uniform and not mottled.

Cane Symptoms—Dwarfing of cane growth is a characteristic of Mosaic. This is not often a striking symptom unless the plants have been infected for several years. In older plantings the stunting effect may be quite pronounced, and infected areas can be recognized readily by a reduced growth with fewer canes.

Fruit Symptoms—On Mosaic-infected plants the fruit is generally small, tends to be crumbly and lacks quality.



Some types of raspberry mosaic, a virus disease. The light areas are pale green to yellow in colour.



Leaf Curl, a virus disease. The leaves are darker green than normal.

LEAF CURL

(Caused by a virus)

Leaf Curl is much less common but is more destructive than the Mosaics.

Symptoms—In contrast to the Mosaics, the leaves of plants affected by Leaf Curl are not mottled, but are darker green than normal, small, and tightly curled downwards and inwards. See illustration on page 35. Infected plants assume an upright habit of growth and are very conspicuous alongside the normal stools. Sucker plants from infected stools are greatly dwarfed and terminate in a yellowish, stunted tip. The fruit of canes affected by Leaf Curl is small, hard, seedy, and of no value.

Control of Mosaics and Leaf Curl—The cultural practices, outlined on page 32, are most important for the control of these virus diseases.

During the first two years after setting out a new plantation make careful inspections, particularly in June, for plants showing Mosaics or Leaf Curl. Dig out all diseased plants including their roots and remove them from the plantation before the leaves wilt. In doing so, keep the diseased plants from touching healthy plants. This will help to prevent the aphids moving from diseased plants and carrying the virus to neighbouring healthy ones. Destroy all diseased plants. Keep the gaps, resulting from this roguing, free of all sucker growth for one year, then the gaps may be reset with healthy plants.

It is not considered practical to rogue old plantations for Mosaics, but when done, remove also the adjoining healthy plants on each side of the diseased plant. On the other hand rogue out all leaf curl plants as soon as observed. This is most important.

ANTHRACNOSE OR CANE SPOT

(Caused by *Elsinoe veneta* (Burk) Jenkins)

This disease is quite common in Ontario. For many years it was of economic importance only on black raspberries and blackberries, but recently it has become of increasing importance on some of the newer varieties of red raspberries.

Symptoms—Any part of the plant above the ground may be affected. In Ontario it is primarily a disease of the canes both young and old. The most conspicuous symptom is the occurrence on young canes of small, oval to circular spots, at first purplish in colour but later whitish to grey with a purple border. See illustration on page 37. These spots may become very numerous and merge to form irregular blotches which sometimes girdle the cane. On severely diseased new canes the tip growth may die back. Old diseased canes may split and dry out.

Cause—The fungus causing this disease over-winters in the spots on the canes, and in the spring produces large numbers of minute spores. These spores are scattered during rainy periods and may infect the new canes.

Control—If the cultural practices outlined on page 32 do not hold this disease in check, it can be controlled by spraying as outlined in the Ontario Protection Calendar for Small Fruits.



Anthraxnose on canes. The spots are grey in colour.

Spur Blight on new canes. The discoloured areas around the buds and leaf attachments are purple to brown. The following year these diseased areas would be grey in colour.

SPUR BLIGHT

(Caused by *Didymella applanata* (Niesse) Sacc.)

This disease occurs almost everywhere that raspberries are grown in Ontario. It is now quite prevalent and has caused serious injury in many raspberry plantations.

Symptoms—Spur Blight may be seen on old or new canes almost any time during the year. In mid-summer, purplish to chocolate brown areas develop on the young canes around the buds and leaf attachments. See illustration on page 37. By the following spring the diseased areas become light grey in colour and are covered with minute, black specks, fruiting bodies of the fungus.

Cause—The fungus overwinters on diseased canes, and spreads by means of spores to other canes the following summer.

Control—Methods outlined for the control of Anthracnose are also recommended for Spur Blight.

CANE BLIGHT

(Caused by *Leptosphaeria Coniothyrium* (Fckl.) Sacc.)

This disease is quite frequently seen in Ontario primarily on red raspberries, but it is generally considered of minor importance.

Symptoms—Diseased canes suddenly wilt and die between the time of blossoming and early fruit development. The affected canes become greyish in colour, and minute, black specks, the fruiting bodies of the fungus, appear over the surface. It may be confused with Spur Blight.

Cause—The fungus overwinters in diseased canes. Infection usually takes place through cane injuries such as insect punctures, or the diseased areas of Anthracnose and Spur Blight. Canes weakened by winter injury are also more liable to become infected.

Control—The cultural practices outlined on page 32 and the prevention of cane injuries should keep this disease under control.

ORANGE RUST

(Caused by *Gymnoconia Peckiana* (Howe) Trotter)

This disease affects both wild and cultivated blackberries, black raspberries and dewberries. It should not be confused with Late Yellow Rust found on red raspberries.

Symptoms—Diseased plants are quite conspicuous by the presence of an abnormally large number of shoots and a distinct upright habit of growth. A yellow glandular coating appears on the under surface of developing leaflets in the early spring. This coating later breaks open and exposes bright orange spore masses. Affected leaves are usually dwarfed and misshapen. Diseased plants never recover.

Cause—The fungus causing this disease overwinters in the bark and wood of stems, crowns and roots of diseased plants. The rust is spread from plant to plant by means of the orange spore masses found on the leaves.

Control—Watch the plantation carefully and dig out, early in the season just as soon as they can be recognized, all bushes affected with rust. Such plants never recover and if they are left for any length of time the rust spores produced on their leaves will be spread to healthy bushes. New plantations should be carefully inspected as Orange Rust may be carried in nursery stock. It is also advisable to destroy any rusted wild blackberries, dewberries and raspberries growing in the neighbourhood of the raspberry plantation.

LATE YELLOW RUST

(Caused by *Pucciniastrum americanum* (Farl.) Arth.)

This rust disease affects red raspberries. It is of minor importance in Ontario except on Viking where it may cause defoliation and also attack the fruit.

Symptoms—Clumps of orange-coloured fungus spores develop on the undersides of the leaves and may also be found on the fruit. Affected leaves turn yellow, then develop brown areas and may drop prematurely.

Cause—The fungus causing this disease lives part of its life on the raspberry and part on the white spruce. It is, therefore, more common in the vicinity of this tree.

Control—The disease is not of sufficient importance to warrant special control measures, but should not be confused with Orange Rust on blackberries.

POWDERY MILDEW

(Caused by *Sphaerotheca humuli* (DC) Burrill)

Powdery Mildew is of commercial importance only on the Latham variety of red raspberry. Warm, humid weather favours the development of this disease. A heavy infection one year may be followed by complete absence the next year.

Symptoms—Recognized by the presence of a white, powdery growth on the leaves and tips of young canes. This powdery growth is more dense on the lower sides of the leaves. Usually first seen at the tips of new canes after they have reached a height of two or three feet. Affected tip leaves are dwarfed, distorted and mottled so that they somewhat resemble leaves affected by the virus Mosaic. The presence of the white powdery growth will distinguish this disease from Mosaic. The tips of affected canes are spindly and have been given the descriptive name "rat-tail".

Cause—The powdery mildew fungus overwinters in affected cane tips and buds. The white powdery mass contains numerous small spores which serve to spread the disease.

Control—There is no satisfactory control. Diseased late-season suckers, not required for next year's crop, should be pruned out and destroyed. Pruning back the fruiting canes to a desirable height in the spring also removes infected tips. In propagative beds "clean-digging", or removal of all hardwood canes, is strongly recommended.

LEAF SPOT

(Caused by *Septoria rubi* West.)

Some seasons Leaf Spot is quite prevalent in late summer, particularly on red raspberries. It may cause the leaves to drop prematurely.

Symptoms—Small, purplish spots develop on the leaves. These spots later become grey in colour and dotted with minute, black specks, the fruiting bodies of the fungus. Severely diseased leaves usually turn yellow and drop.

Cause—The fungus causing this disease is spread by means of spores produced in the minute, black specks on the leaf spots.

Control—This disease is not of sufficient importance to warrant special control measures.

CROWN GALL

(Caused by *Agrobacterium tumefaciens* (E. F. Sm. & Town) Conn.)

This is a common disease of red raspberries in Ontario. It is seen on the roots of red raspberries and on the crowns and canes of black and purple varieties. Crown Gall also affects the blackberry, dewberry and our tree fruits, such as the apple, peach and plum.

Symptoms—Red raspberry bushes affected by Crown Gall have galls or knots on their crown and roots. These swellings vary from the size of a pea to that of an apple. They are white at first but become brown and warty with age. Later they usually decay. Crown Gall on the root of a raspberry plant is illustrated on page 41. On purple and black raspberries, warty galls appear on the canes near the crown.

Cause—The bacteria which cause Crown Gall are commonly present in orchard and garden soils. These bacteria enter the tissues of the plants through wounds such as those made by cultivating implements and insects.

Control—In setting out new plantations use only stock which is entirely free of Crown Gall. Do not plant on ground which has been recently used for raspberries, blackberries or fruit trees. Avoid injury to the crowns and roots when cultivating or hoeing. The effects of Crown Gall on the plants can be overcome to a great extent by proper fertilizing and by cultural practices which promote vigorous growth.

WILT

(Caused by *Verticillium albo-atrum* Reink. and Berth)

This disease is also called Blue Stem. It is found throughout the Province in red and black raspberries. Black raspberries are more susceptible and are killed by it more rapidly than are red varieties. The disease is seldom serious in older plantations, but is important in those of one to four years old. It is generally more severe in poorly drained locations, and in seasons of abundant spring moisture. The disease appears suddenly with the onset of hot and dry mid-summer weather.

Symptoms—The lower leaves of affected plants wilt, turn yellow and fall. The leaves are shed from the ground upwards until the canes are bare or nearly so. The loss of leaves is usually followed by a bluish or purplish discolouration of the canes and then death. These defoliated bluish canes are very conspicuous and can hardly be overlooked even by a casual observer. It should be kept in mind, however, that healthy canes of some varieties assume a blue colouration and therefore this character alone should not be used as a symptom of Wilt.



Crown Gall on the roots of a red raspberry.

Cause—The fungus causing this disease will live for years in the soil, and attacks raspberry plants through the roots. It will also attack tomatoes, potatoes, egg plants, and peppers.

Control—(1) Plant only healthy, certified stock. (2) Do not plant tomatoes, potatoes, egg plants or peppers between raspberry rows, and do not plant raspberries on soil in which these crops were grown the previous year. (3) Cut out and burn infected canes of red raspberries but dig out and destroy the entire plant of diseased black raspberries. (4) Do not replant raspberries in areas where Wilt has occurred.

Acknowledgement

The writer wishes to thank Mr. G. C. Chamberlain, Dominion Laboratory of Plant Pathology, St. Catharines, Ont., for major contributions including the illustrations of virus diseases and Spur Blight; the Dept. of Bacteriology, O.A.C., for illustration of Crown Gall; and the Dept. of Public Relations, O.A.C., for illustration of Anthracnose and Spur Blight, and also for preparation of plates.

Growers should also consult the current Ontario Protection Calendar for Small Fruits for the latest control measures for the above listed insects, pests and diseases.

THE SOYBEAN AS A GRAIN CROP IN ONTARIO

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by

I. M. ROBERTS and G. P. McROSTIE

DEPARTMENT OF FIELD HUSBANDRY

ONTARIO AGRICULTURAL COLLEGE



"The growing of soybeans is now big business on many Ontario farms."

ONTARIO DEPARTMENT of AGRICULTURE

STATISTICS AND PUBLICATIONS BRANCH, TORONTO, ONTARIO

BULLETIN 474

FEBRUARY, 1950

THE SOYBEAN AS A GRAIN CROP IN ONTARIO

FEW crops in the history of Ontario agriculture have had the phenomenal increase in acreage that has been experienced in the case of the soybean during the past decade. It is true that this crop has been grown experimentally in Ontario for many years, and to a limited extent for the production of grain by a few farmers in the South Western parts of the province. However, it is only in the past eighteen years that the crop was considered of sufficient importance to be recorded in provincial agricultural statistics.

In 1932 the acreage was recorded as 7,781. For the succeeding nine years the acreage remained between 8,602 and 11,272. The demand for oil and protein during war years, coupled with a very substantial increase in price, raised the acreage nearly four hundred per cent. These increased production figures have not only held their own in the years since the war ended, but by 1949 had more than doubled from the highest war year production. Most recent figures for soybean production in 1949 are in the neighbourhood of 110,000 acres.

The fact that soybean acreage has more than doubled since the war years with no increase in price would indicate that many farmers have found the crop a desirable one to include in their regular rotational programme.

Some of the factors that have helped to bring about this better understanding of the possibilities of soybeans as a grain crop are discussed in the following pages of this bulletin.

1. WHERE TO GROW SOYBEANS

(a) With the wide range from early to late soybean varieties available, there is no climatic limitation to where they may be grown in old Ontario. Until recently it was felt that profitable production of soybeans was confined to Essex and Kent Counties. Now, high-yielding, early maturing varieties have made the greater part of old Ontario a potential soybean area with yields and net returns comparable to other cash crops.

(b) Soybeans are adapted to a wide range of soil types, but do best on loam soils. Good corn land is good soybean land. They will produce a fair crop on light, sandy soils, or soils too poor for growing a high yield of corn. The soybean will do better than clover on soils of low fertility or on acid soils, but for best results acid soils should be limed and soils low in fertility supplied with the elements in which they are deficient.

(c) Soybeans are not as sensitive to drought or high moisture conditions as corn.

2. SOYBEANS AND THE SOIL

The common belief that soybeans are a "poor land crop" is not true. While soybeans will produce better than most other crops on soils of low fertility, it is the highly fertile, highly productive soils that pay off. A high yield of soybeans will not occur on a field where you expect a low yield of corn or other grains.

(a) The soybean is a legume, and when properly inoculated gets most of its nitrogen from the air. When harvested with the combine, removing only the seed and returning the straw, the soil nitrogen is not depleted. Evidence from experimental work indicates that as much as 16 pounds of nitrogen per acre may be added to the soil by plowing in soybean straw. When compared to a non-legume crop like corn where there is a 50-pound nitrogen loss per acre for a 50-bushel yield, soybeans are certainly soil building from a nitrogen standpoint.

(b) Soybeans draw heavily on minerals. A 20-bushel crop will remove almost as much phosphorous and twice as much potash as a 50-bushel yield of corn. Soybeans also remove more calcium and magnesium than corn. Continued growing of large crops of soybeans for market purposes will gradually deplete soils of these minerals and if profitable yields are to be maintained it is necessary to return to the land the phosphates, potash, and lime taken off by the crop. While soybeans are not as responsive to direct fertilizer applications as some other crops there is no doubt about their extensive utilization of soil minerals, and the need of adding such plant foods.

(c) Organic matter is the life of the soil and just as important a part of it as minerals. By returning the soybean crop residue—roots, stems, and leaves—anywhere from two to four tons of precious organic matter is incorporated into the soil. Never burn or otherwise destroy this valuable portion of the crop.

(d) Soybeans improve soil tilth and physical condition through their ability to loosen and mellow the soil surface. This tilth-improving property is of definite value on heavy clay, clay loams, and silty clay loam soils.

(e) Along with the improved physical condition brought about by soybeans, as a direct result of this open, porous condition of the soil, there is an increase in the number of soil bacteria and other living organisms.

(f) On rolling, or sloping land soybeans, like other inter-tilled crops, will cause some erosion. The soil conservation practice of contour planting is to be recommended strongly for the more extreme slopes. In all cases the rows should be planted in a direction at right angles to the general slope of the field.

3. SOYBEANS IN THE ROTATION

(a) Soybeans may either follow or precede corn. On the average they yield best after fall-plowed sod while corn usually yields better following soybeans. Soybeans leave a field in excellent physical condition for small spring grains with a minimum of preparation. Tests at many experimental stations have shown that small grains yield better on soybean stubble fields than following corn or other small grains. Therefore, the place of soybeans in the rotation can be considered only in terms of the whole rotation and as to whether they will precede or follow corn depends entirely on the farmer's preference.

(b) Soybeans will do better after soybeans, but successive growing of the crop for three or four years is not a good rotation practice, and will increase the possibilities of disease.

(c) Soybeans should be considered as a "secondary", not a primary legume in the rotation and should not replace such crops as clovers and alfalfa.

(d) Early varieties may be used to permit planting of fall wheat after soybean harvesting. This is an excellent practice on rolling land because wheat prevents excess erosion from fall rains and spring wash. Winter wheat, following a soybean crop, cannot immediately make use of the nitrogen residue from the soybean. Therefore a fertilizer containing nitrogen should be applied when planting the wheat.

4. PREPARATION OF SEED BED

Poor stands and weed competition are two main causes for crop failure in soybeans. It is much easier to kill weeds before soybeans are planted than afterwards; consequently practices should be carried out to cause as many weed seeds as possible to germinate before planting time. To assist in good seed germination and resulting good stands the seed bed should be firm underneath and mellow on top. With these two important objectives in mind the following tillage operations could be recommended:

(a) Fall plowing is preferable to spring plowing, especially in case of sod on all but light sandy loam soils. Fall plowing allows for weathering and settling of the soil, and, moreover, weed seeds near the surface of a fall-plowed field germinate earlier than weeds that are moved to the surface by spring plowing. In the case of spring-plowed sod, when the soil is loose and filled with undecayed crop residue, care must be taken to pack the seed bed to ensure sufficient moisture for good germination.

(b) Disc the land at intervals of approximately ten days, or as often as a crop of weeds appear.

(c) Give a final discing and harrowing immediately before planting.

(d) When sowing in dry soil, germination of the seed will be increased by the use of a roller or cultipacker immediately after planting.

5. DEPTH OF SEEDING

The depth of seeding should be determined by the soil type and moisture conditions. Planting at from 1 to 2 inches is preferable, but the seed should be placed in moist soil. In a dry spring, or on light soils this may necessitate deeper planting.

Shallow planting has several advantages:

(a) The upper layer of soil is warmer and brings about more rapid germination. This permits soybean seedlings to compete more effectively with germinating weeds.

(b) More rapid emergence lessens danger of delay by formation of a soil crust. If such a crust forms, it should be *broken with a rotary hoe, finger weeder, or harrow.*

6. TIME OF PLANTING

Soybeans may be sown over a longer period than most other crops. Seeding time varies greatly, depending on location and on the year. As you travel from Windsor to Guelph you pass through four climatic zones (see map on Page No. 16). Generally, in Zones No. 1 and 2 seeding may commence the first week in May, and be continued through until the middle of June. In Zone No. 3 seeding should not begin before the 15th of May, and in Zone No. 4, not before the 24th of May and preferably the first week in June.

(a) The controlling factor for time of seeding should be soil warmth. Since soybean seed germinates slowly in cold soil and grows slowly in cool weather there is no advantage in very early planting. Cool weather does not usually retard weed development to the same extent as it does soybeans. Around corn planting time is a good time to sow soybeans.

(b) Thorough weed control before planting justifies delay in seeding.

(c) Where seeding is delayed because of wet soil or because of the necessity of extra cultivations to control weeds, the use of earlier varieties than usually planted is recommended.

7. SOW ONLY GOOD SEED

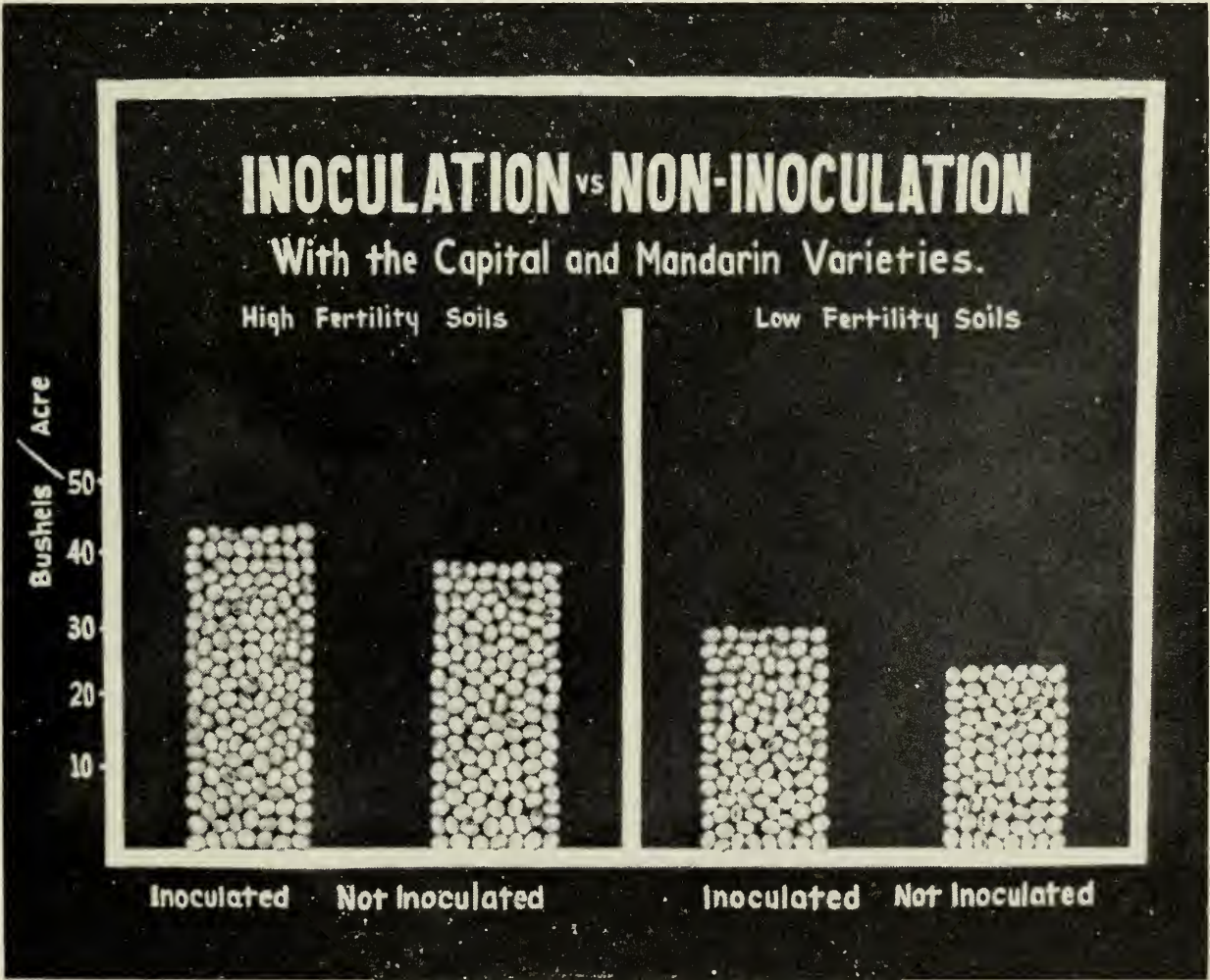
(a) It is sound practice to purchase Registered or Certified Seed at least once every three or four years. This is a means of periodically purifying your seed insofar as mixtures are concerned. It is a greater insurance against disease, and ensures high germination. New varieties, in particular, should be obtained from a registered or certified seed source.

(b) Seed germinating 85 per cent or better should give satisfactory field stands. Allowance should be made for lower germination by thicker seeding. It is easy to run a germination test of your own by planting fifty seeds in a sand-filled, flat box. Place the box in a warm, dry place, sprinkle with water daily, and, at the end of ten days, count the plants. The number of seedlings that emerge, multiplied by two, is the germination percentage.

(c) Preferably plant seed grown the previous year. Experiments have shown that the ability of soybean seed to germinate decreases rapidly with age. Not only is germination affected, but the seed appears to lose its vitality and many seedlings from even two-year seed fail to produce healthy plants.

(d) Seed should be cleaned of inert materials, weed seeds, splits, and foreign seeds, and uniformly graded to avoid weedy fields and spotty stands.

(e) Several forms of seed protectant dusts may be purchased for treatment against disease. As a result of research on the effectiveness of these dusts in preventing seed-borne diseases, the Dominion Experimental Station at Harrow recommends the practice of seed treatment. These dusts are most effective in increasing seed germination and yield in a year when seed generally has undergone extensive weather damage, or of particular lots of seed that have cracked coats, etched coats, or are mildew-encrusted. Also, in a wet, cold spring, where germination is retarded or slowed up, these dusts give protection to seeds and seedlings in the ground against rotting.



Inoculation pays dividends.

8. INOCULATION

The ability of soybeans to take nitrogen from the air and use it in growth and seed manufacture is brought about by the presence of a special type of bacteria in the soil. Unless these bacteria are present the soybean has to draw its supply of nitrogen from the soil like corn or oats, or any other non-legume. The bacteria form nodules in the roots of the soybean plant in which they live and carry on their functions of gathering nitrogen from the soil, and changing it into a form that can be utilized by the plant.



When properly inoculated nodules develop freely on the roots of soybeans.

The first and foremost aim is to insure that bacteria are present. Several commercial forms of soybean inoculant can be obtained from any seed store. Necessary instructions for applying inoculum are supplied with cultures and should be followed carefully.

(a) In tests at Guelph on low fertility soils, inoculation increased the average yield per acre by 5.2 bushels, or 17.2 per cent.

(b) In similar tests on high fertility soils, inoculation increased the average yield per acre by 3.1 bushels, or 7.8 per cent.

(c) The increased yields brought about by inoculation were due to an increase in the number of pods per plant, plus an increase in the percentage of three-seed pods at the expense of two-seed and one-seed pods.

(d) Some seed disinfectants interfere with the growth of the bacteria used in inoculation. Use a type of chemical that does not do this.

(e) Seed should be planted as soon as possible after it is inoculated, at least within twenty-four hours after treatment. The use of artificial heat or strong sunlight to dry inoculated seed will weaken or destroy the bacteria.

(f) One of the most frequent causes of low yields with soybeans is lack of, or carelessness in, inoculation.

(g) Make sure it is *soybean* inoculant that you are using.

(h) It is particularly essential to inoculate soybean seed which is to be planted in a field which has not been seeded to soybeans for several years.

(i) The farmer who does not inoculate his soybean seed at every planting is taking an unnecessary risk. A good commercial culture costs only a few cents, and the labor entailed in inoculating procedure is negligible.

9. METHOD AND RATES OF SEEDING

(a) Numerous types of equipment can be used for seeding. The grain drill makes an excellent job and is rapidly gaining in popularity. Spouts that are not required to give the desired row width can be easily closed off. The corn planter and the beet and bean drill also do a perfect job, providing they can be adjusted to the desirable row widths.

(b) Solid planting of soybeans is not usually advisable because of the fact that it is impossible to carry out weed control measures after the crop has reached a height of eight to ten inches. Low yields frequently result through weed competition. Only when the history of the field indicates a high degree of freedom from weeds should solid planting be practiced. This type of planting should be last in the seeding schedule to allow for adequate before-seeding weed control. Seed from 1½ to 2 bushels per acre if planting solid.

(c) Soybeans are usually planted in rows rather than solid. There are many advantages to such a method of seeding:

- (1) Yields on the average are higher;
- (2) Greater opportunity for weed control;
- (3) Earlier maturity and combining;
- (4) Taller growth of soybean plants;
- (5) Less delay in combining due to matted, weedy soybeans;
- (6) Lighter seeding rates;
- (7) Less lodging.

(d) Yield of soybeans will increase as rows are narrowed from wide 42-inch and 36-inch rows down to 21-inch rows. The most important factor determining row width will be the available row cultivation equipment and the tractor width. As a recommendation we would suggest the narrowest row that it is practical to handle with available equipment, preferably not over 28 inches wide.

(e) In the 1949 High Yield Soybean Contest for Ontario the 21-, 22-, and 24-inch rows averaged 38 bushels per acre, as compared to 31.3 bushels per acre for 28-inch rows. These averages included all soybean varieties.

(f) In tests at Guelph with the Mandarin variety over a period of three years yields for different row widths were as follows:

- | | | |
|------------------|---|---------------------------|
| (1) 21-inch rows | : | 37.8 bushels per acre |
| (2) 28-inch rows | : | 33.2 " " " |
| (3) 35-inch rows | : | 30.4 " " " |

Distance Between Rows (Inches)	VARIETIES					Mean Yields per Acre (Bushels)
	Lincoln	Harman	Earlyana	Mandarin	Capital	
21, 22, and 24	41.7	39.4	40.3	38.8	34.2	38.0
28	35.2	30.3	31.5	27.9	30.4	31.3

"The 21-, 22-, and 24-inch rows well outyielded the 28-inch rows in the 1949 High Yield Soybean Contest."

(g) Dropping seed approximately an inch apart in 28-inch or wider rows, and between an inch and an inch-and-a-half in 21-, 22-, and 24-inch rows gives highest yields. Amount of seed required will vary with variety and size of seed, but, on the average, seeding at this thickness will require at least a bushel of seed per acre.



Studying the effect of varying distances between rows at the Ontario Agricultural College.

(h) Thick seeding is especially important for weed control purposes. One should expect, with a proper series of weed control treatments, to sacrifice from eight to ten per cent of the soybean plants.

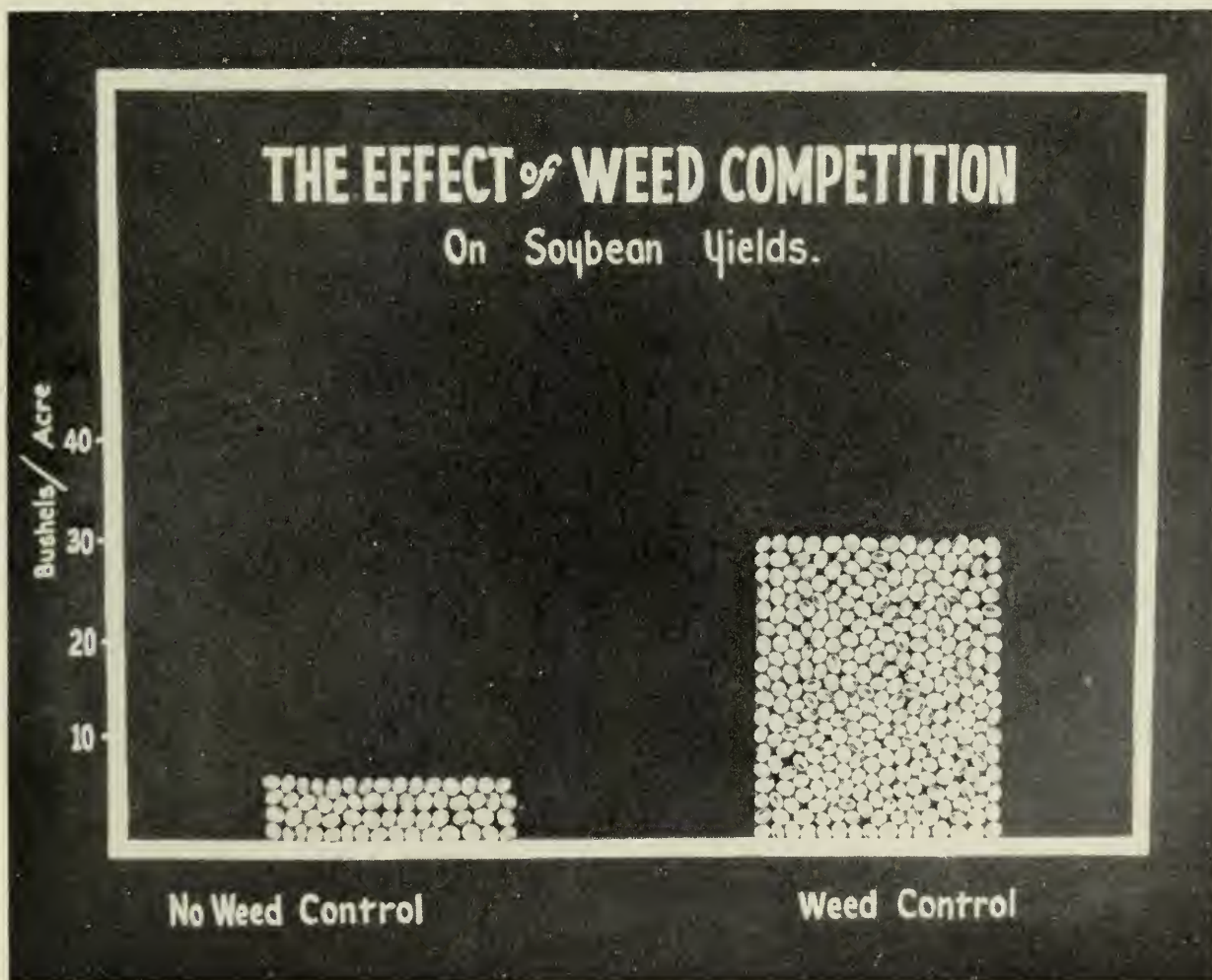
(i) Tests at Guelph have shown that thicker seeding of the earlier, low-podding varieties forces higher podding from the ground, hence reducing loss of seed during combining. Thickly-seeded soybeans stand a better chance of breaking a hard surface crust.

(j) Care and a little extra time in seeding is time well spent. Maximum yields come only from perfect stands. Seed at a uniform depth and with an even, uniform distribution of seed throughout the rows.

10. WEEDS VS. SOYBEANS

Weed control is the most important single factor determining success or failure in soybean growing. Soybeans will not compete with weeds, and unless the grower is aware of this and does something about it he will be disappointed in his soybean yields.

In tests at Guelph over a period of two years, where weeds were allowed to run and no weed control carried on, weed counts showed an average of 122 weeds per square yard. Where timely weed control measures were practiced, weed counts showed on the average less than a single weed per square yard. Yields on weedy areas were approximately six bushels per acre as compared to twenty-eight bushels per acre on clean plots.



There is money in weed control.

This difference in weed population and in yield per acre was brought about by three "timely" treatments of the soybeans with harrow, weeder or rotary hoe, and once through with the row cultivator. At present market price for soybeans each single weed control operation increased gross returns by \$13.75 per acre.

11. WEED CONTROL IMPLEMENTS

(a) The rotary hoe does an excellent job. It is probably the most efficient implement for large scale operation. It is best suited to clay type soils, but will also do a fair job on lighter soils.

The rotary hoe is not being used to proper advantage until the whole top crust or layer of soil is being turned over to expose weed roots. To do this the speed to travel will vary with the type and condition of the soil. Ten to twelve miles per hour is not unusually fast for the rotary hoe. Depending also on soil type, the rotary hoe may have to be weighted.



The finger weeder makes a good job of weed control.

(b) The finger weeder does a good job on weed control in soybeans, especially on loam and lighter soil types. In cases where the weeder is attached to hydraulic-lift equipment the fingers can be set to run at any desired depth to meet requirements of soil and weed conditions. It can be moved through soybeans at four to six miles per hour without doing them any harm.

(c) A set of ordinary, light, spike-toothed harrows will also do a good job of weed control. However, the forward motion of the harrow cannot exceed three to four miles per hour without doing excessive crop damage. When used intelligently the harrow is a useful implement in weed control.

Lack of equipment is not a problem, nor an excuse, in weed control, when any one of the above-mentioned implements, used intelligently and at proper times, will adequately control weeds.

(d) Many types of row cultivators are used. The main requisite is that they be capable of destroying weeds between the rows of soybeans, and that they can be operated successfully at shallow depths. Shallow, level cultivation



Weeds can be successfully controlled in the soybean crop.

is the most satisfactory. The beet and bean cultivators can be strongly recommended for soybeans. Avoid, if possible, hilling soil around soybeans. Also avoid tearing up and cutting off valuable soybean roots by too deep cultivation.

12. METHODS OF WEED CONTROL

(a) Weed control measures must be followed at the right time. These “timely” measures are indicated by the weeds themselves and by moisture conditions. If weeds are allowed to grow until they are firmly rooted, then they will withstand harrowing, etc., almost as well as the soybeans. Harrowing, weeding, or using a rotary hoe under damp conditions and on sunless days only serves to change the position of weeds. These implements disturb weeds, expose their roots to the sun, and it is the burning rays of the sun that actually does the greater part of the killing.

(b) The first treatment should be given when weeds are “in the white”. Finger over the top crust of soil, and if it is full of white, thready structures, the weeds are just coming through. If these are disturbed and brought to the top, a large percentage of them are destroyed. This stage may occur before soybeans are up, while they are just coming through, or after they are up.

(c) A second treatment should follow when weeds are again just showing through the ground, and successive treatments at similar stages of weed development until the soybeans would be too severely damaged by such vigorous control measures. Three times through usually takes care of the weed situation.

(d) The rotary hoe and the finger weeder can be used in the soybeans until they are ten to twelve inches high; the harrow, until they are eight to ten inches high.

(e) These implements may be used either in the direction of the row or across the row in earlier stages of soybean growth. When plants have reached a height of seven to eight inches it is advisable to keep tractor wheels between rows. A cross treatment when soybeans are four to five inches high has the effect of fingering out weeds between soybeans in the rows.

(f) These treatments are best carried out in the heat of late morning and afternoon, when soybean plants are in a wilted condition and hence have a smaller tendency to break off.

(g) When the soybeans are too tall for harrowing, etc., row cultivation should be practiced.

(h) Row cultivate to kill weeds, but cultivating too deeply and closely to rows will destroy valuable soybean roots.

(i) Soybeans will withstand vigorous cultural treatment, although immediately after they may look to be damaged. However, they soon regain their previous healthy appearance. The greatest failure is in the grower himself lacking courage to cultivate in a sufficiently thorough manner to secure best results.

(j) Good weed control is not being secured satisfactorily unless a few soybean plants are being destroyed. Planting at least a bushel of seed per acre allows for such damage and still ensures a good stand of soybeans.

13. VARIETIES

The large number of varieties of soybeans now available may make selection of a variety confusing for the new grower.

(a) Soybean varieties, like corn, vary in their "time to maturity". This variation in "time to maturity" is desirable due to great variation in climatic conditions in Ontario. For example, Essex County has a longer frost-free period, and hence a longer growing season than Wellington County. Southern Ontario has been divided into five climatic zones to simplify the recommendation of soybean and corn varieties. Recommendations for these zones are based on results of numerous variety tests which take into consideration not only time to maturity but also yield, soil adaptation, lodging, etc.

(b) The new grower should follow these recommendations closely. The use of a variety that is too late for an area is likely to result in damage to the harvested crop by frost and in a moisture content too high for most efficient combining. Soybeans containing over fourteen percent moisture are more difficult to store and are subject to a reduction in market price.

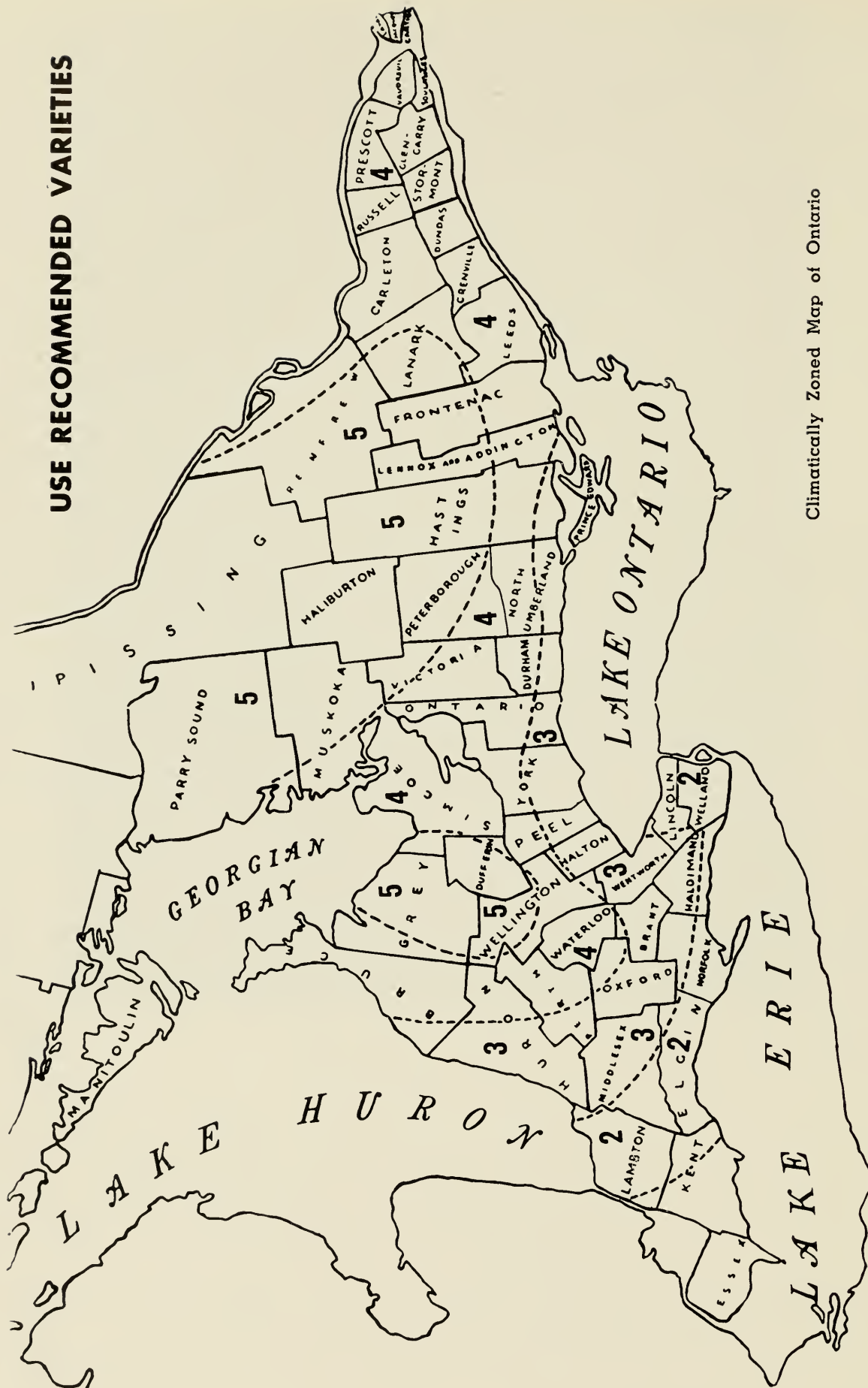
(c) Check the zonal map on Page 16 and determine your zone. The following is a list of the recommended varieties by zones. They are divided into groups of later- and earlier-maturing varieties for each zone, and all varieties are listed in order of lateness.



A well-podded soybean plant.

	LATER MATURING	EARLIER MATURING
Zone 1	Lincoln, A.K., Harman, Hawkeye	Earlyana, Blackhawk, Monroe, Harly
Zone 2	Harman, Hawkeye, Earlyana, Blackhawk	Monroe, Harly, Mandarin, Capital
Zone 3	Earlyana, Blackhawk, Monroe, Harly	Mandarin, Capital
Zone 4	Mandarin, Capital, Goldsoy	Flambeau, Kabott, Pagoda
Zone 5	Flambeau, Kabott	Pagoda

USE RECOMMENDED VARIETIES



Climatically Zoned Map of Ontario

14. HARVESTING

(a) Soybeans are ready for harvesting when leaves have dropped off and pods and stems are brown and dry. The pods will split open when squeezed between thumb and forefinger when ready for combining. Dry beans will break entirely across when you bite them. If they are still "cheesy" the moisture is likely too high for safe storing.

(b) The combine is the most satisfactory machine for harvesting soybeans. If the grower does not own a combine it will pay to secure the use of one on a custom basis. Sufficient extra seed will be obtained from the combine to warrant a rental proposition over other methods of harvesting. Care should be taken, however, to see that the operator of the combine is efficient in his work, and has his machine in proper adjustment.

(c) Combines should be carefully adjusted to prevent damage to the seed. A closer adjustment of cylinder and concave is possible in early morning when the seed is damp. As the seed becomes drier the clearance between the cylinder and concave should be increased. Thus several adjustments may be necessary in a day's operation.

(d) Splits, damaged soybeans, and excessive dockage, result in a lower market grade, and consequently a lower price.

15. STORAGE

While it is less work to sell the soybean crop as soon as combined, storage of seed on the farm is frequently desirable.

Such storage has several definite advantages: (1) The marketing of the harvested crop can be distributed over a longer period; (2) Prices are usually higher after the main crop has been disposed of; (3) The orderly marketing of any crop prevents congestion in the processing plants and permits of more efficient moving of the crop by transportation companies.

The following are some essentials in soybean storage:

(a) Soybeans should be under fourteen per cent moisture for best storage. If over fourteen per cent, spoilage may result from heating, especially during warm spring days. If trouble is being experienced in getting beans down to fourteen per cent in an average year it is most likely the fault of too late a variety being grown for the particular locality.

(b) They may be stored in dry bins similar to those used for other grains like oats, barley, or wheat. Tightness of the bin is the most important single factor. The advantage of storing dry beans is lost if bin construction is such that moisture is allowed to enter through cracks, holes, and other defects.

(c) Soybeans should not be stored directly on concrete unless it has been thoroughly waterproofed. Condensation of moisture on untreated concrete

may contribute to spoilage. The use of a wooden floor over concrete will help to prevent such spoilage. It is recommended that beans be not stored at greater depth than around four feet.

(d) Low temperatures do not present a problem with seed for processing purposes, but if being used for seed, freezing injures the embryo and poor germination results if the moisture content is over 14 per cent.

(e) Soybeans may be stored in a dry room in sacks piled broadside in rows with alleys between rows to allow for air circulation. It is advisable to place two rows of 2 x 4 scantling underneath each pile to keep sacks off the floor, particularly in case of concrete floors, and also to allow for air circulation underneath piles. For storage of small quantities for feeding on the farm bag storage offers many advantages.

16. FERTILIZER

While soybeans are less responsive to fertilizers on fertile, productive soils than most other crops, this is not an indication that soybean is a light feeder, and that, as a result, no addition of minerals is required. It simply means that soybeans make better use of residual fertility.

On good fertility soils where a planned crop rotation is being followed fertilizer allotted to soybeans will often show more response if applied on the previous crop, that is, in addition to the fertilizer allotment for the previous crop. On soils low in fertility, and on light or sandy soils, direct fertilizer applications very definitely increase yields.

(a) As a general recommendation, 200 to 300 pounds of a 2-12-6 fertilizer is usually satisfactory.

(b) On light soils, soils low in fertility, or low in potash, a large increase in yield may be expected from applications of 200 to 400 pounds of 0-12-20, or 2-12-16. Where potash deficiency symptoms have appeared in the previous crop, or previous soybeans, then fertilizers high in potassium should be added.

(c) Although well established soybeans can take nitrogen from the air they depend entirely on soil nitrogen during the first few weeks of their growth, and if such is not available, undergo a nitrogen-starvation period. Where there is doubt in relation to soil nitrogen supply, some nitrogen should be added with other minerals in the fertilizer.

(d) It should be remembered always that yield is influenced by fertility. Fertility can be built up by addition of organic matter through use of green manure, barnyard manure, and crop residues; and nitrogen, phosphate, and potash, by means of commercial fertilizers.

(e) Organic matter is the life of the soil. On strictly cash crop farms where no barnyard manure is available special attention should be paid to maintenance of an organic matter level by means of green manures and crop residues.

Although soybeans themselves add a large quantity of organic matter to soil under proper management, somewhere in the rotation, a healthy crop of clover or alfalfa should be plowed under.

(f) On acid soils limestone should be added. In addition to correcting acidity of the soil it also furnishes lime or calcium to the plant. Limestone also provides a more favourable growing condition for the bacteria which help the plant get atmospheric nitrogen.

(g) Soybean seedlings are very subject to injury from fertilizers, and for this reason seed should never be drilled in direct contact with fertilizer. Unless the drill or planter separates the seed from the fertilizer when planted together, the fertilizer should be drilled into the soil or broadcast and disced or harrowed in before seeding is done.



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SMALL FRUITS

FOR THE

HOME GARDEN



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THE TERM "small fruits" may include almost any of the fruits that grow on bushes, vines or herbaceous plants rather than on trees. For the purpose of this article it will be limited to strawberries, raspberries, currants, gooseberries and blueberries.

SMALL FRUITS FOR THE HOME GARDEN

Strawberries

The strawberry is undoubtedly the most popular of the small fruits. It is the first fruit to ripen and can be grown almost anywhere in Ontario. It thrives best on well-drained sandy loam but will usually grow on most garden soils; poor dry sand and gravel or heavy cold clay should be avoided.

SOIL PREPARATION: Preferably, the ground should be prepared during the year before planting by growing a hoe crop such as beans or corn; if this is kept clean many weeds will be destroyed. Also, some of the value of manure and fertilizers used for these crops will be carried over in the soil for the strawberry plants. If the above treatment is omitted, select clean land and give a good dressing of manure—two or three bushels per 100 square feet. This should be plowed or dug in the fall previous to planting and left in that condition until spring. In the spring apply some good mixed fertilizer, such as 4-8-10, using about one to one and one-half pounds per 100 square feet of area; scatter it on evenly and work it in well before planting. If the soil is fairly rich smaller quantities of fertilizer will suffice.

PLANTING: Strawberries are usually planted in the spring as soon as the ground can be prepared. Late summer planting (end of August) can be done with success if there is sufficient moisture in the ground (water of course can be applied on a small plot) and if well-rooted plants are available. In the late fall planting (November) there is some danger from heaving in the spring due to alternate freezing and thawing. A mulch of hay or straw will help to prevent this heaving.

In the "matted row" system, 18 inches is a good distance to set the plants. Varieties that form only a few runners may be set closer—15 inches. Those that produce more and longer runners should be given more room—up to 24 inches. Rows are generally spaced three and one-half to four feet apart. In the hill system plants are usually set closer together—12 to 15 inches, as by this method all runners are removed and the main plant only is left to develop into a large crown.

Use only vigorous, healthy plants. Those that are black rooted should be discarded, as they are old, diseased, or have been injured by adverse weather and soil conditions. Before planting clean up the plants by removing old dead leaves, runners and straggly ends of roots.

SETTING AND CARE OF YOUNG PLANTS: A spade or pointed long-handled shovel is commonly used for setting the plants; for only a few plants a trowel may be used. Set the plants firmly and at the proper depth. The crowns must be level with the surface of the soil, if too deep the plants smother and rot and if too shallow they dry out.

After setting the plants, hoe thoroughly to destroy weeds and to keep the soil mellow. Pick off all blossoms during the growing season after planting, to encourage vigorous growth. During this first summer a little extra nitrogen fertilizer is of value in promoting growth and formation of blossom buds for next season's crop, particularly on soil that is not very fertile. This fertilizer



Do not transplant strawberry plants with black roots, as shown on the right. Use plants having live healthy roots, as shown on the left, for best results.

should be in the form of ammonium nitrate or similar material. Apply as a side dressing not less than six inches from the plants using about one-quarter pound per 25 feet of row, using one-half this quantity four or five weeks after planting and the rest four or five weeks later.

In a home garden it pays to space runner plants four to six inches apart and remove surplus runners.

MULCHING: Covering the plants in the late fall with three or four inches of hay or straw is a good insurance against winter injury. It must be removed in the spring as soon as signs of new growth appear. If left between the rows it will help smother weeds and keep the fruit clean.

RENEWING THE PLANTATION: A plantation that is vigorous and healthy may be kept for a second and sometimes a third fruiting season, after which it should be discarded.

As soon as the fruit is picked, hoe out the old plants and all weeds. Work the ground up around the plants that are left, and at the same time apply some nitrogen fertilizer—ammonium nitrate, one-quarter pound per 25 feet of row. This will encourage the growth of the new runners which will form the new fruiting row.

Varieties

Many varieties are being offered growers but only six are noted in order of maturity.

Valentine is a new early type that is a vigorous grower and good cropper. Fruit is firm, dark red and of medium quality; good for dessert and home canning.

Premier is the standard commercial variety in the milder parts of Ontario. It is a good grower and cropper having fruit which is moderately firm and of very fair quality. It ripens several days later than Valentine.

Senator Dunlap is a good grower and profuse plant maker, being useful in the colder parts of Ontario. Fruit is small to medium in size, of fair quality and ripens early.

Dorsett is a good grower and fair cropper that is firm and of good quality. It is moderately early.

Fairfax is a good grower and fair to medium cropper. Fruit is firm, dark red and of excellent quality and ripens in midseason.

Sparkle is a new sort imported from New Jersey that is a good grower and cropper. Fruit is firm, of good quality and attractive in appearance, ripening in late mid-season. It is valuable as a freezing variety.

Raspberries

The red raspberry is the most commonly grown in Ontario, the black and purple kinds being planted to a lesser extent. Raspberries thrive in good garden soil providing it is well-drained. Dry sand or gravel and heavy clay are less desirable than a fertile sandy loam.

SOIL PREPARATION: As the raspberry plant may last from six to twelve years or more, care should be exercised in preparing the soil. It should be of high fertility and free of such perennial weeds as quack grass, Canada thistle, sow thistle and bind weed. If these weeds are present a special effort must be made to eradicate them by careful digging or thorough cultivation during the season previous to planting. When weeds are eliminated a good dressing of well-rotted manure using three or four bushels per 100 square feet plus one pound to one and one-half pounds of 4-8-10 fertilizer should be applied during the late summer or fall before planting and thoroughly worked into the soil.

PLANTING AND AFTER CARE: Red raspberries may be planted in the fall or spring but blacks and purples are better left until the spring. In reds, vigorous well-rooted young canes of the current season's growth are used for fall planting or quite early spring planting. Later in the spring, young shoots that come up then may be used if well rooted. As black and purple raspberries do not send up sucker plants, rooted "tip" plants must be used instead.

Raspberries are usually grown in continuous rows; the plants are set two to three feet apart with six or seven feet between rows in the home garden but greater distances in commercial plantations.

PRUNING RASPBERRIES



Red raspberry bushes as they appear before being pruned. Thinning and pruning can be done in the summer after fruiting or left until the next spring.



The same bushes with the old wood and unthrifty canes cut out at the ground level. In the spring new canes can be headed back by one-third their length.

Plant firmly, taking care not to injure the roots and young growing shoots. Following spring planting, keep the ground free of weeds by hoeing and cultivation. If planting is done in the fall draw extra soil up around the plants with a hoe or by shallow plowing, this will check "heaving" of the plants by freezing and thawing.

In addition to the farm manure applied at the time of soil preparation, annual applications of two or three bushels per 100 feet of row may be given, also one pound per 100 feet of row of 4-8-10 fertilizer may be used each year. If mulching is practiced less manure will be needed but more 4-8-10 should be used, probably twice as much.

PRUNING: At the time of planting, cut the canes off about one foot from the ground. This forces lower buds into growth making stockier plants which are less liable to suffer from drying out or from wind injury. Also, it greatly reduces the number of blossoms and fruits that first year which helps the plant to become established.

After fruiting, cut out the old wood and unthrifty canes at ground level, leaving only the strongest new canes for fruiting the next season. This thinning of canes may be left until the spring; also at that time the new fruiting canes may be headed back leaving two-thirds of their length. To avoid possible damage by wind very tall canes may be partially headed back before winter sets in. Tipping back new shoots in summer is not advisable for red raspberries but is generally recommended for black and purple raspberries, and should be done when they are about two feet high thus forcing out strong side shoots.

Varieties

Only a few varieties are mentioned, and these are in the order of ripening:

Trent (Red) is a moderately vigorous grower and good plant maker. Somewhat susceptible to mosaic. Fruit medium or less in size, dark red and soft. Useful for earliness on local markets. Apt to suffer from red spider in dry seasons.

Viking (Red) is a vigorous grower and good cropper; large and firm, fine for dessert and for quick freezing. It ripens in early midseason.

Newburgh (Red) is quite hardy in most areas although it has been known to freeze back some years. The fruit is very large, roundish, firm and very meaty, of fair to good quality. The fruit does not pick readily until well ripe. It is a good cropper and ripens in early mid-season, about with Viking.

Taylor (Red), a good grower and cropper, having large, firm and good quality fruit. It is a late variety.

Latham (Red) is vigorous and hardy; is a good cropper having large, roundish, sometimes crumbly fruit. It has only fair quality.

Cumberland (Black), moderate grower and good cropper, having early, medium size, good quality fruit.

Morrison (Black), vigorous grower and good cropper. Fruit is large, of good quality and late to ripen.

Sodus (Purple) is a very strong grower and good cropper. Fruit is large, of good quality and ripens in midseason.

PRUNING BLACK CURRANTS



A black currant bush that has not received sufficient pruning in previous years. Much of the old wood should be completely removed at ground level.



The same bush after rather severe pruning. One and two-year old wood gives the best fruit and should be retained. Young shoots should not be cut back.

Currants and Gooseberries

These fruits grow well in most good garden soils, but prefer, however, a cool, moist and fairly heavy clay loam. Light sand and gravelly soils are too hot and dry for best results.

SOIL PREPARATION AND PLANTING: Currants and gooseberries are heavy feeders and if the ground is not naturally fertile it should be given a heavy dressing of farm manure—three or four bushels or more per 100 square feet. This should be worked into the soil well by plowing or digging. Planting is usually done in the fall because of the difficulty of getting on the ground early enough in the spring before the buds burst.

Strong, well-rooted, one year-old plants are the best to use although two year-old plants may be used, but they are not as easily moved and cost more.

Set the plants four or five feet apart in the row, using the greater distance for the blacks. If there is more than one row, space them six to eight feet apart. Commercial plantings are set as much as ten feet between rows.

CULTIVATION, MULCHING AND FERTILIZERS: Work the soil sufficiently with hoe or cultivator to keep down weeds but do not cultivate too deeply as these fruits are shallow rooted. A depth of two to three inches will be sufficient.

Mulching with hay or straw is beneficial as it keeps the soil cool and moist and also builds up organic matter in the soil. If used in large enough quantities it will keep down weeds and make cultivation unnecessary. Once started, mulching should be continued as it encourages surface rooting and plowing or cultivating in this condition would destroy many feeder roots. These remarks on cultivation and mulching apply also to the raspberries.

In addition to the manure and fertilizer applied during soil preparation, annual applications should be made of one bushel of manure to two or four plants depending on age and size, and about two ounces of 4-8-10 per plant increasing to four or five ounces, as the plants grow in size.

PRUNING: One and two year-old wood in the black currant gives the best fruit and so most of it should be retained, cutting out the older wood: young shoots should not be cut back. In red currants and gooseberries most of the fruit is borne on spurs on the older branches, hence, more of this old wood should be left. It is necessary, however, to remove a few of the oldest branches from time to time, and thin out some of the young shoots to prevent the bush from becoming too dense. Some heading back of strong young shoots is often advisable in red currants and gooseberries.

Varieties

Magnus (Black fairly vigorous grower, productive, having clusters of medium size with large fruit. The fruit ripens evenly.

Climax (Black), vigorous, erect grower, productive, having clusters of medium size; berries are medium to large and uniform. Ripens later than Magnus.

Naples (Black), an old standby which is vigorous and productive. Fruits vary in size and ripen late.

PRUNING RED CURRANTS



A red currant bush before it has been pruned. Most of the fruit is borne on spurs on the older branches, thus more of the older wood must be left intact.



The same bush after pruning. It is necessary to remove a few of the oldest branches and thin out some of the young shoots or bushes become too dense.

Red Lake (Red) is vigorous but rather sprawly. It is productive. Berries are light red and of good quality.

Stephens #9 (Red) is vigorous but rather sprawly. It is productive. Clusters are medium to large, having large berries, which are less acid than some.

Clark (Gooseberry), moderately vigorous and productive, having good quality, large fruit; reddish color when ripe.

Poorman (Gooseberry) is vigorous and productive but prefers heavy soil. The fruit is medium in size, red when ripe and of good quality.

Silvia (Gooseberry), vigorous, hardy and moderately productive. The fruit is medium in size, red when ripe and of good quality.

Blueberries

Probably no fruit has aroused as much interest of late years as the blueberry. This has been due, no doubt, to its great popularity as a wild fruit, the introduction of better types for cultivation and to increased publicity.

The blueberry is probably the most sensitive of any of our fruits to soil conditions. The soil needs to be quite acid (pH 4.0 to 5.5) and if it is not naturally in this condition chemicals such as sulphur, aluminum sulphate and crude tannic acid may be added, or acid peat may be used. **This, however, is feasible only on a small scale and lasting results are uncertain.**

Soil moisture needs to be fairly constant; if too dry, the plants fail to thrive and blossom buds do not form. On the other hand too much water can be quite injurious. Organic matter is of great importance as it helps to control water conditions and indirectly affects growth and yield.

Generally speaking most areas of naturally suitable blueberry soil are of a sandy or peaty nature or a combination of both and unless soils are more or less naturally suitable it is questionable whether any attempt should be made to fit them for blueberry culture.

PLANTING AND AFTER CARE: Two year-old plants that are well rooted should be used. Set them five or six feet apart on the square or four feet apart in a single row. They should be handled carefully to avoid breaking the roots and to retain as much earth as possible.

Fertilizer should not be put in the holes next to the roots but peat may be mixed with the soil using a shovelful to each plant. Some mixed fertilizer, such as 4-12-6, with a little extra nitrogen, may be applied as a top dressing, using two ounces per bush the second year from planting. This amount may be increased slightly each year up to six or seven ounces per bush, depending on the amount of growth.

At planting time it is best to cut off all fruit buds otherwise very little pruning is needed until the third year, then only small bushy growth near the base is taken out. From then on a light pruning each year is satisfactory, removing dead wood, broken branches, large clusters of thin wood and branches that are too near the ground. Pruning may be done any time after leaf fall until spring.

A mulch of sawdust, six to eight inches thick, will conserve moisture and help to control weeds.

FARM WATER SUPPLY

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FARM WATER SUPPLY

SOURCES

The most important part of any water system is the source of supply. To be satisfactory it should meet the following requirements:

1. **ADEQUATE VOLUME** to meet all requirements.—This feature warrants careful consideration particularly when a modern automatic system is being installed on an old well or other source of supply. It has been found that with a modern pressure system approximately six times as much water is used on the farmstead as when it had to be pumped and carried by hand. In Table (1) is shown the approximate daily water consumption for various purposes where it is available on tap.

TABLE I
DAILY WATER REQUIREMENTS

Each member of family	30	gal. daily
" Dairy Cow	30	" "
" Beef Cow	10	" "
" Horse	10	" "
" Hog	2½	" "
" Sheep	2	" "
" 100 Chickens	5	" "

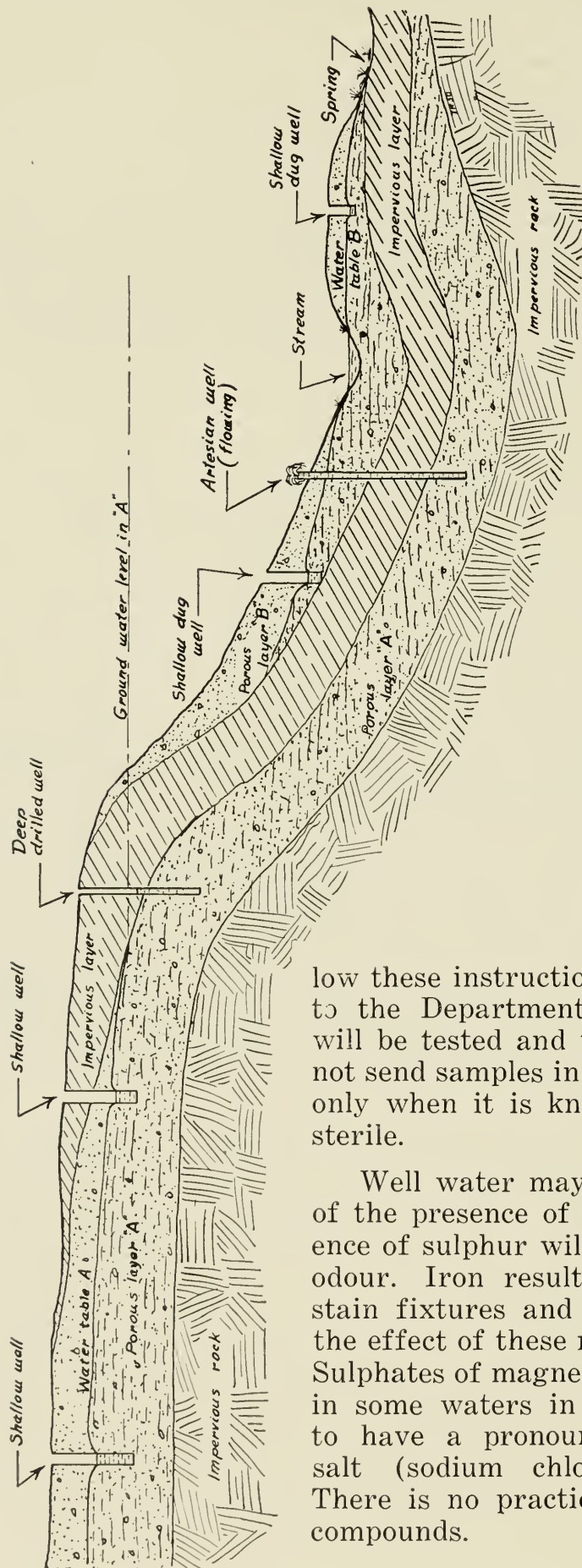
From this table the total daily water requirements may be calculated. For instance, a well supplying water to a family of five, 20 head of dairy cattle, and 300 chickens, should be capable of supplying:

5 people x 30	150 gallons per day
20 dairy cattle x 30	600 gallons per day
300 chickens x 5/100	15 gallons per day
A total of 150 + 600 + 15 equals	765 gallons per day

2. **DEPENDABLE** at all times—farm water requirements are unfortunately heaviest in the driest seasons of the year when sources of supply are at the lowest level. It is important that a contemplated source be investigated carefully to ensure that the capacity available will meet requirements under the driest conditions.

3. **GOOD QUALITY**—Two factors should be considered in judging the quality of water. The most important of these, from the standpoint of human consumption, is **Bacterial Content**. Many diseases such as dysentery, typhoid fever, etc., can be caused by water-borne bacteria. Families using such water continually may build up a certain resistance to these germs. However, a stranger can be seriously affected by it. Bacterial pollution is generally caused by entry of contaminated matter from privies, cesspools, or septic tanks into ground water, or by entrance of contaminated surface water or filth into the well itself. By this means disease-producing bacteria which may be present in sewage can be transmitted to others in the drinking water. The water may appear pure and sparkling, and still be contaminated. Naturally any well in which the water develops off-flavours or becomes turbid after a rain will be suspected of pollution, but no well should be assumed safe unless bacterial tests of the water are taken at regular intervals.

Fig. 1—The Occurrence of Ground Water



In order to reduce the dangers of pollution, the well should be carefully located and constructed. Well location with respect to possible sources of pollution is covered on Page 4. Entrance of surface water must be prevented. This may be done by watertight construction of the casing for the upper ten feet in depth, by covering the well with a watertight concrete cover, raised above the level of the surrounding land, and sealing pump or drop-pipe openings.

If priming any pump becomes necessary, use only water suitable for drinking. Wells are frequently polluted through using impure water for this purpose.

The Department of Bacteriology, Ontario Agricultural College at Guelph, provides a free water-testing service. It is only necessary to write to the department, requesting this service. Sterile sampling bottles, instructions for sampling, and a questionnaire, will be provided. Fol-

low these instructions, return the samples by mail to the Department of Bacteriology, where they will be tested and the results will be mailed. Do not send samples in other bottles, as tests are made only when it is known the bottles are absolutely sterile.

Well water may also be unfit for use because of the presence of **Mineral Compounds**. The presence of sulphur will give the water a disagreeable odour. Iron results in bad tastes and tends to stain fixtures and clothes. Treatment to reduce the effect of these materials is covered on Page 38. Sulphates of magnesium and sodium are also found in some waters in concentrations strong enough to have a pronounced laxative effect. Common salt (sodium chloride) may be present also. There is no practical treatment to remove these compounds.

GROUND WATER

THE OCCURRENCE OF GROUND WATER

Ontario is fortunate in having dependable ground water sources available in most areas. Ground water, as obtained from wells and springs, is usually preferable to surface water from lakes and streams.

Water occurs in the soil in several ways. The soil moisture found near the surface in well drained areas, upon which plants depend for their water supply, is of no value as a source of water for other purposes, as it clings tightly to the soil particles. To be of use for farm water supply, water must be present in such a manner that it may be drained from the soil. This requires that the spaces between the soil particles be filled with water, and that these spaces be large enough that the water may drain out of them. The upper limit of the occurrence of free water in the soil spaces is known as the water table. Water may be obtained below this level from sand or gravel or from porous or fissured rock.

In most areas one or more layers of sand, gravel, or limestone are found at varying depths below the water table, and provide a good source of water. The typical occurrence of such layers is shown in Fig. 1. Springs are caused by outcroppings of such layers at the surface, which allow water to escape. Wells penetrate the water-bearing layer, so that water drains into them until the water in the well is at the level of the surrounding water-table.

Nearly all ground water is supplied by rainfall penetrating the soil. The height of the water-table may vary, being highest following a heavy rainfall, and lowest following droughts. Natural forest cover, and well managed land help rainfall enter the soil. Lowered water tables result from removal of forests and bad soil management practices. The water table may also be lowered by draining swamps, and by heavy pumping of wells such as has occurred in some intensively irrigated areas.

Many shallow wells, which penetrate only a little deeper than the water table, will be affected by fluctuations in the water table. If the water table lowers below the bottom of the well because of any of the above-mentioned causes, the well will become dry. If the bottom of such a well remains in a sand or gravel formation, deepening the well may correct the trouble. Frequently, however, wells are dug past the water bearing layer, to provide extra storage capacity. In such cases deepening the well will not increase the flow, unless a deeper water bearing stratum is penetrated.

Usually the most dependable sources of water, particularly where large quantities are required, are the deeper water-bearing layers, which are tapped by deep drilled wells. Water from deep wells is usually colder and is less likely to be contaminated than that from shallow wells. However, it usually has a higher mineral content.

LOCATION OF WELLS

In many areas the only thing necessary to obtain a dependable supply of water is to sink a well into a suitable water-bearing layer. In most areas these water-bearing layers extend for miles in all directions; hence it is not a problem of striking a vein or an underground spring, as is commonly believed. In such areas wells can be located anywhere that is convenient and safe from pollution.

In other districts water-bearing strata are not continuous, and locating water becomes much more of a problem. In these circumstances, no one can be sure where water will be found, except by drilling test wells. Many claims are made by "water-diviners" but these are entirely without scientific basis, and most successful drillers ignore them.

Although it is impossible in such cases to know where water will be found, a thorough knowledge of the area will help one to decide where is the most likely place. Local well drillers usually have a good practical knowledge of their district and should be able to decide on the most probable location.

As an aid in determining the possible location, as well as the type and depth of well required, and quality of water, neighbouring wells should be investigated. Usually the wells in a locality will derive water from the same stratum, so one could expect to obtain water from the same level as the neighbouring wells, and would also expect a similar quality of water. Similar information may be obtained by consulting the logs of wells drilled in the area. A well driller's log is a record of the materials encountered and the depth and quality of water, if any, obtained. The Geology Branch, Department of Mines, Parliament Buildings, Toronto, keeps the logs of wells drilled in Ontario.

Wells must also be located for convenience. Whenever possible the well should be located close to the house, thus simplifying installation of pumping equipment. If within a few feet of the basement walls, an installation such as that shown in Fig. 21 is possible, with resulting ease of access to pumping equipment.

Freedom from bacterial pollution is important. All wells must be so located that the danger of pollution is minimized. They should be on a higher elevation than any nearby sources of contamination such as privies, septic tank disposal beds, or barnyards. Never locate a well less than 50 feet from a possible source of pollution. In open, gravelly soils, or shallow limestone this distance must be increased greatly. Surface drainage must be away from the well.

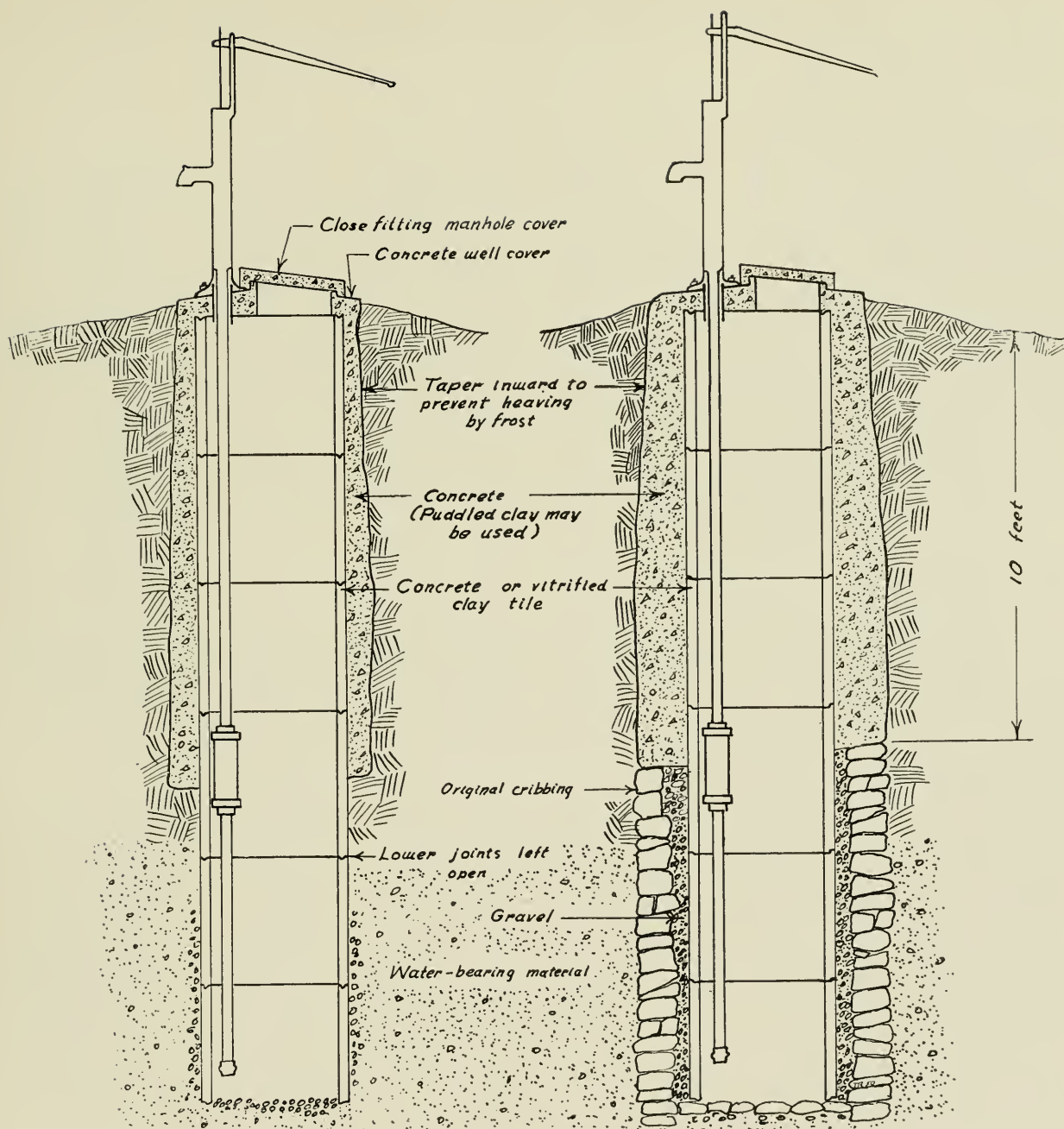


Fig. 2—Dug Well Construction

TYPES OF WELLS

Dug Wells

Dug wells are used in areas where a dependable supply of ground water exists at a reasonable depth and in material which may be excavated by a pick and shovel. As they are generally dug by hand, and all excavated material must be hoisted out of the well, they are seldom more than 30 feet in depth. The diameter varies, but must be great enough for the digger to work conveniently. Hence they are usually three feet or more in diameter. Greater diameters than three feet are of little advantage, and add to the cost of the well, but they do supply added water storage, which is important where the flow into the well is weak.

Dug wells are usually cribbed with cement or vitrified tile. Since dug wells are very liable to pollution the upper ten feet of casing should be set

with water tight joints, and protected with a concrete cover. Such a well is shown in Fig. 2.

Reconstruction of Old Dug Wells

Many old dug wells were cribbed with stone or brick, laid with open joints to the ground surface, and with wooden covers. These offered no protection against the entrance of contaminated surface water. Such old wells, however, may be made safer by installing water-tight concrete or masonry cribbing for the top 10 feet and filling the space around the cribbing with puddled clay, or by setting concrete or glazed tile inside the old cribbing, filling the space between the old cribbing and the tile with gravel to within 10 feet of the surface. The top 10 feet of old cribbing should be removed, and the space between the tile and the earth filled with puddled clay or cement after the upper tile joints have been carefully sealed. A water-tight concrete top raised above the surrounding land should be used to prevent accumulation of surface water. These treatments are shown in Fig. 2.

Drilled Wells

Drilled wells are usually the most dependable type of well. They are constructed by a well drilling rig, which drills the hole and sets wrought iron casing, usually 4" in diameter. A drilled well may be of any depth, in many cases 200 feet or more. Water from such a well is less likely to be polluted, and is seldom affected by drought.

Drilled wells, unless they obtain water from a rock stratum, should have a screen installed to prevent entrance of sand and gravel. Such screens are obtainable in varying sizes and lengths, and with openings suited to all grades of water-bearing material. A drilled well obtaining water from a sandy or gravelly stratum will not be satisfactory unless a proper screen is installed. After installation the well should be "developed" by pumping or surging, to draw the fine material from around the screen into the well, whence it may be removed by bailing. If this is not done the full capacity of the well may not be realized and the pumping equipment may be damaged by sand. Where water is obtained from a rock stratum, a screen is not necessary. However, it is most important that the casing be driven down into the rock, and sealed to the rock to prevent soil entering. Failure to do this will result in ruining the well in a short time.

Drilled wells should be protected against contamination by placing a layer of puddled clay or cement around the casing near the surface, and by being protected with a concrete platform to shed surface water away from the casing. The casing should extend at least six inches above the surface, or above the bottom of the pit, and the space between the casing and drop-pipe sealed with a suitable well seal, to protect the well in case of flooding.

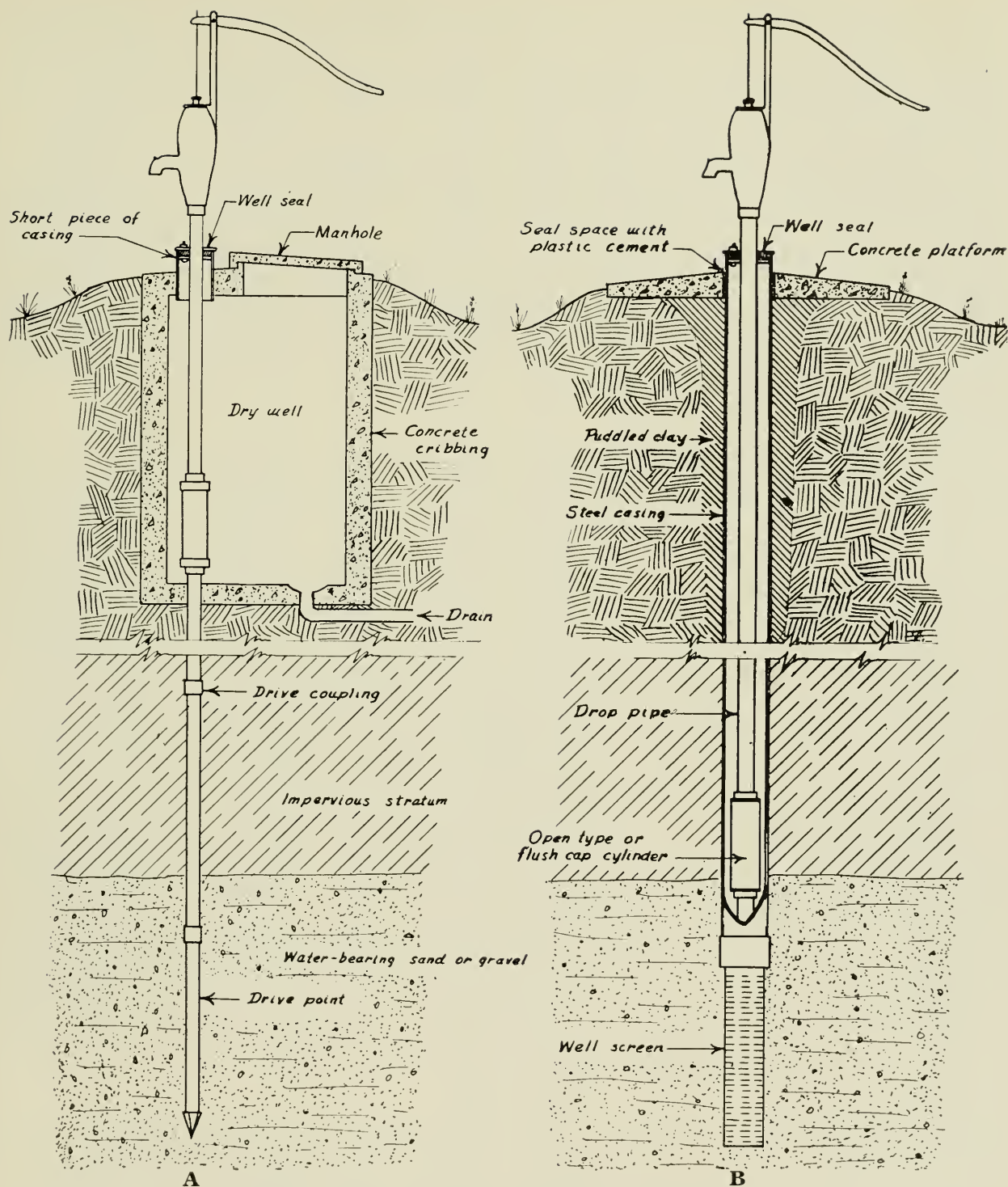


Fig. 3—Drilled and Driven Well Construction

Driven Wells

Where a water-bearing layer of sand or gravel exists within 20 feet of the surface, and the soil is not too stony, a drive-point may be forced down to the water on the end of a pipe which then serves as the pump's drop-pipe. Drive-points vary from $1\frac{1}{4}$ " to 2" diameter and are about 30 inches long. The hollow iron point is perforated and covered with a fine brass screen which prevents sand from entering the point. The point is connected by means of a special drive coupling to a length of pipe protected by a driving cap and driven into the ground by a maul or drop weight. An auger of the same diameter as the point may be of use in boring the hole before insert-

ing the point and driving it down. As the point is driven, additional lengths of pipe are connected. Tests for water may be made by lowering a plumb bob in the pipe, or by pumping. Care must be taken that the point is not driven through the water-bearing layer into impermeable material beneath.

If larger amounts of water are required than one point can supply, several points may be sunk a few feet apart, and connected together below frost level, so that one pump may be used. Frequently it is necessary to place the cylinder below ground level, either to protect it from frost, or, where water occurs at a depth greater than 22 feet, to locate it within suction distance of the water. In such cases the drive-point may be driven into the bottom of a dry well or pit, in which the cylinder will be placed. This pit must be carefully protected against entrance of polluting matter, and should be drained. See Fig. 3A.

Tubular Wells

Tubular wells are quite similar to driven wells, but are constructed by drilling or jetting through the casing, which is usually 2" pipe, the casing being driven down as drilling proceeds. A tubular well cylinder is first connected to the lower end of the casing, and protected by a drive shoe. When water is reached the casing is raised a few feet, and a flush point, similar to a drive point, is driven through the casing. A special coupling on the flush point seats on the inner flange of the drive shoe, making a sand-tight joint. A check valve and plunger are then installed in the cylinder. Sometimes tubular wells are constructed using the rough casing as the cylinder. The saving in first cost of these is soon lost in wear on leathers and in efficient operation.

As the cylinder is directly above the point the depth of this type of well is not limited by suction lift as it is in the driven well. Construction of a tubular well is shown in Fig. 4.

Bored Wells

In some areas wells are sunk by boring with a special soil auger. They range in depth from 20 to 50 feet, and are of varying diameters. In small bored wells iron pipe may be used for casing, in larger ones sheet steel, or concrete or vitrified tile, may be used. Usually the lower section of casing is perforated to allow free flow of water, or a screen may be used.

SPRINGS

Springs form an important source of water in many localities. However, contrary to popular belief, spring water is very likely to be polluted, especially if no precautions

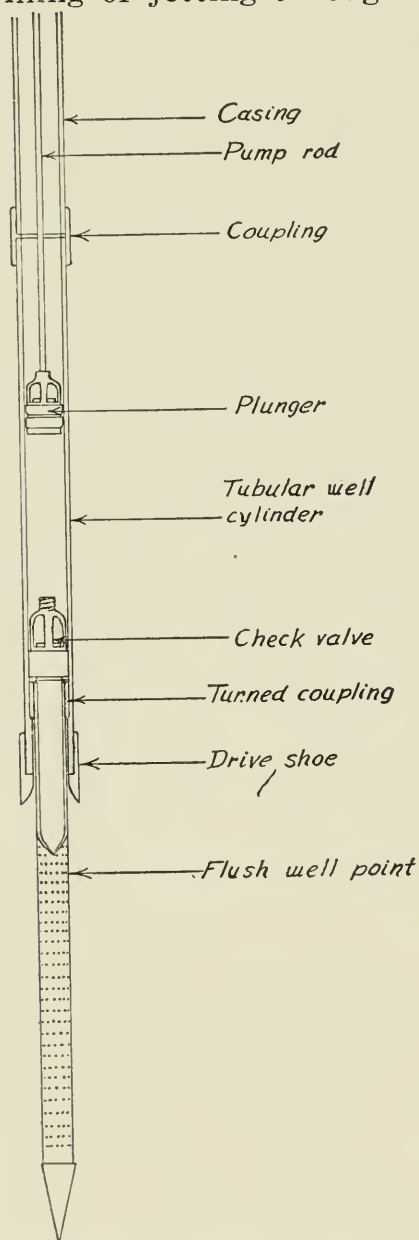


Fig. 4—Tubular Well Construction

are taken to exclude animals and to prevent dirt and surface water from entering.

If sufficiently far above the level of house and barn, water may be supplied by gravity from the spring. If below, water may be raised to the buildings by a hydraulic ram, if the flow from the spring is sufficient to operate a ram, or water may be pumped from the spring by an electric pump. However, before installing equipment for any such supply, the flow should be checked to see that it is adequate and dependable, and that the water is safe to use.

Where a spring is satisfactory for household supply it should be improved by cleaning and be cribbed and covered to exclude surface water, and fenced to prevent access of livestock, as shown in Fig. 5.

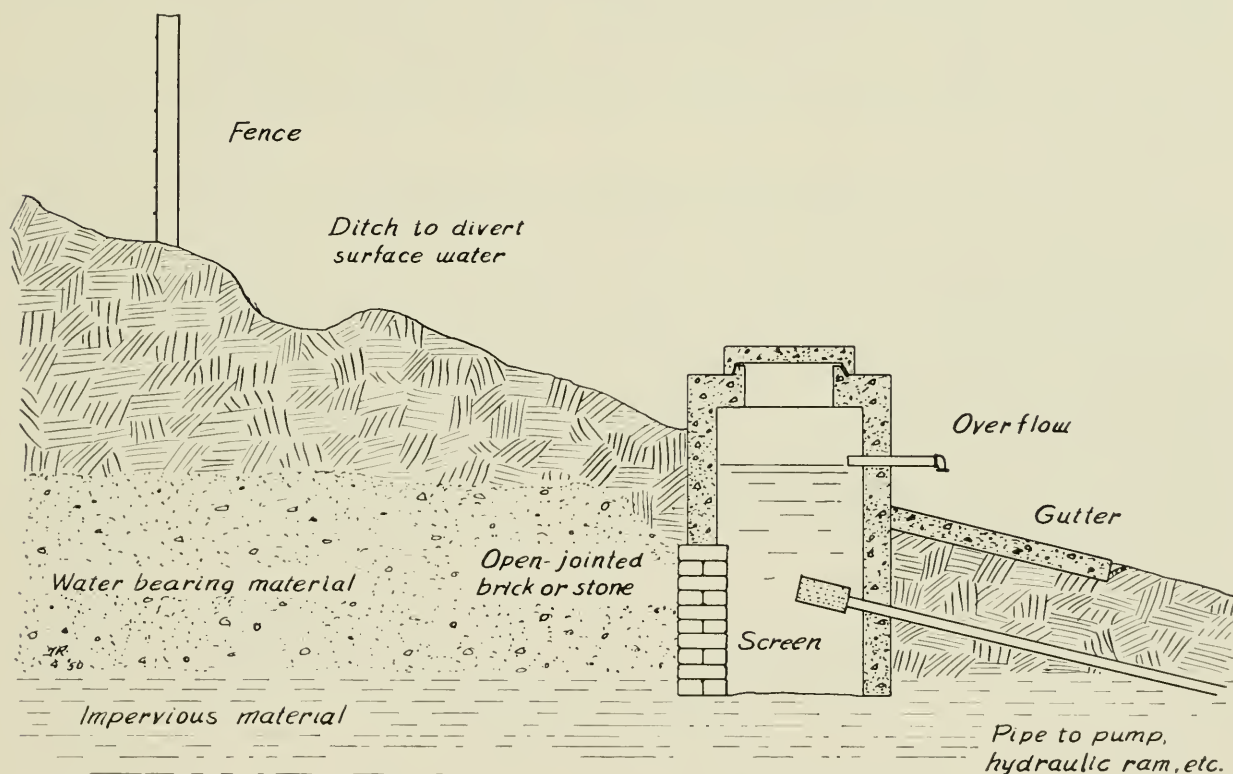


Fig. 5—Spring Protection

CISTERNS

The advantages of soft water are well known to every housewife. Hard water is wasteful of soap, leaves a dull film on laundry and dishes, and a ring around the bathtub. It also damages heaters and kettles by scale deposits. In the past cisterns were used universally to supply soft water for laundering and bathing. However, with the advent of domestic water softeners the cistern has lost some of its advantages. A large capacity softener can be bought for less than the cost of an adequate sized cistern and shallow well pump.

Cisterns, however, are still necessary in many cases. Where the ground water supply is inadequate a cistern may form a supplementary supply to reduce the drain on the well. In some localities well water is unfit to use because of sulphur, iron or mineral salts, and cistern water must be used for all household purposes. It should be filtered and sterilized by chlorination or boiling before drinking. Cisterns may also be used where running water is not available, and a softener cannot be used.

How to Estimate the quantity of Soft Water that can be collected from a building

Multiply the horizontal guttered roof area (length times width of building) by the rainfall in feet, then multiply the product by $6\frac{1}{4}$ (1 cu. ft. equals $6\frac{1}{4}$ Imp. gallons). The amount collected should be three-quarters of the result, allowing for one-quarter of the rainfall being wasted.

For example, average monthly rainfall in Ontario is nearly 3 in. Find the amount of water which would be collected from the roof of a building 30 ft. x 40 ft. in one month.

Solution: $30 \times 40 \times 3/12 \times 6\frac{1}{4} \times \frac{3}{4}$ equals 1400 gals. approx.

It is recommended that a cistern be large enough to store three months rainfall. This means the cistern for the above building should have a capacity of 3×1400 equals 4200 gallons.

A cistern 8 feet square and 10 feet deep would be satisfactory.

Construction

Cisterns should be built of reinforced concrete. Other materials, particularly brick, have been used, but are not recommended, as they are more likely to leak.

In most cases a square or rectangular shape is recommended. A round cistern is strongest, and most economical of materials, but the difficulty of building circular forms offsets these advantages. Information on concrete mixes and reinforcing is available from the cement companies. Particular care should be taken in the construction, to eliminate the possibility of leaks, and an adequate overflow supplied, since a leaking or overflowing cistern may damage adjacent foundations and cellar floors. A manhole in the top must be provided to permit cleaning and repairing when necessary.

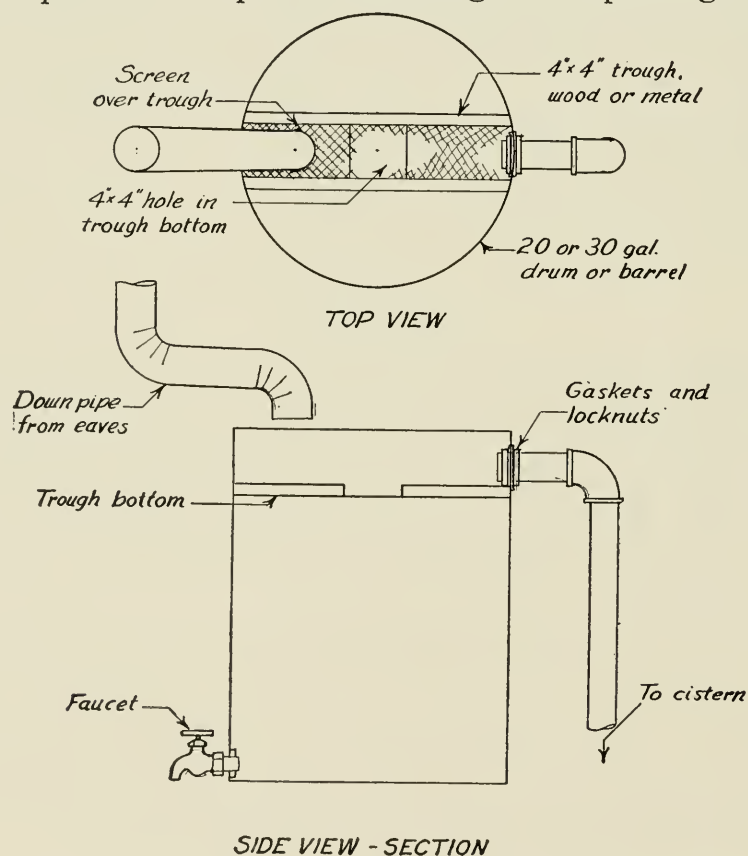


Fig. 6—Roof Wash Device

Protection

Cistern water frequently develops disagreeable odours unless care is taken in construction and maintenance. A cistern should be protected to exclude leaves, soil, insects, and vermin. This can be done by building a tight-fitting cover, and by screening inlet and overflow. The first runoff from the roof should always be wasted, as in the first few minutes of rainfall the rain carries a large amount of dust from the air, as well as dirt, leaves, etc., which have accumulated on the roof. This may be done by installing a switch in the down-pipe, allowing the water to run to waste for a few minutes at the beginning of each rain before switching it into the cistern. However, it is much more convenient to have this done automatically. The device shown in Fig. 6 does this. At the beginning of a rain the barrel is empty, so that the first few gallons of water will enter the barrel. When it is full the water continues on into the cistern, disturbing the water in the barrel very little. Between rains the faucet, which is set to drip slowly, allows the water in the barrel to escape, so it is empty for the next rain. This method will do a great deal to eliminate odours from the cistern water.

SURFACE WATER SUPPLY

In some areas where adequate supplies of ground water are unobtainable, surface sources must be relied upon for part or all of the farm needs. The source may be a stream, pond, lake, or a specially built dugout.

Surface water has been used for years for watering stock, but should only be considered for household use in cases of extreme necessity. It is almost certain to be polluted, is frequently turbid, and may have an unpleasant taste and odour. If no other supply is available it may be used for the household, but should be very carefully treated to reduce the danger of disease.

A filter well, shown in Fig. 7, may be used to reduce the turbidity, but must not be depended upon to remove harmful bacteria. It is absolutely essential that all such water used for drinking or cooking be carefully sterilized by boiling or chlorination (See Page 39).

Existing ponds may often be improved by deepening and cleaning, or streams may be dammed, to provide greater water storage for the dry periods. Cattle should not be allowed access to ponds or dugouts, as not only will they foul the water, but will trample the banks and dam, eventually ruining the pond. Instead, the pond should be fenced, with water carried to a stock tank below the dam or pumped if sufficient fall is not available. Where the supply of ground water is limited, surface water may be used for stock and other purposes, thus conserving the ground water for household use.

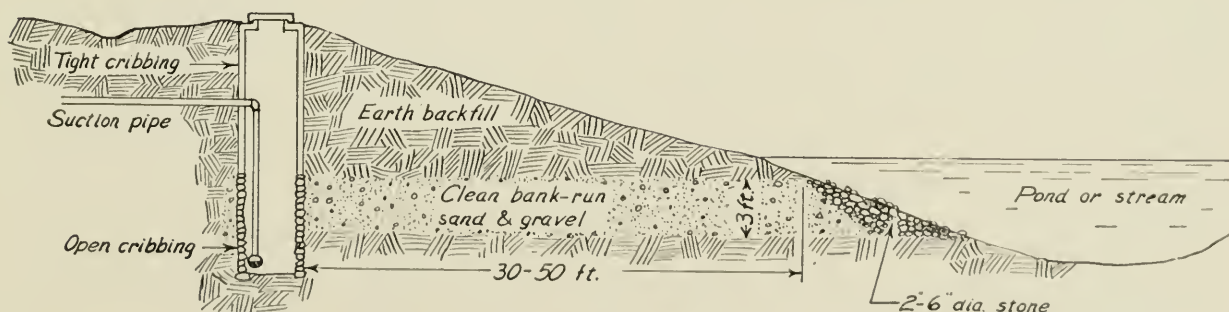


Fig. 7—A Filter Well

WATER SUPPLY SYSTEMS

While many hand-operated pumps are still sold for installation in areas where electric power is not available, or where economy is the chief consideration, the problems of selection and installation of these are not difficult. Consequently this bulletin will deal chiefly with the selection, installation, and operation of power operated pumps. Of these the most desirable are electrically operated, if electricity is available, with gasoline engine driven and windmill pumps used where electric power is unobtainable.

Electric pumps are manufactured in a wide variety of types and capacities. The major problems are in determining the type, capacity, and method of installation best suited to the particular need. In order to do this some knowledge of pump operation is required.

All pumps operate by creating an increased pressure at the outlet and a reduced pressure or partial vacuum, at the inlet. This partial vacuum permits atmospheric pressure, acting on the water in the well, to force the water up the suction pipe to the pump.

Theoretically, it is possible for atmospheric pressure at sea level, to force water up a pipe 33.95 feet. However, in practice the maximum which can be depended upon is 22 feet. This means that the pumping mechanism must be within 22 feet, vertically, of the water at all times. The vertical distance between the water surface and the pump is called suction lift. Another factor which enters into the suction lift of a pump is pipe friction between the water and the pipe. In small pipes this friction can seriously reduce the effective suction lift of the pump. The combination of vertical distance between the water surface and the pump and the head required to overcome pipe friction, is the total suction head the pump must work against. Friction losses may be reduced by the use of large pipe, with as few elbows and fittings as possible, and with short runs of pipe.

The 22 foot limit on suction lift makes it necessary to have two classifications of pump. For applications where the water surface is within 22 feet vertically of the pump location, shallow-well pumps are built. These must be used only where the water surface never falls more than 22 feet below the pump. For wells where the distance between the water surface and pump is greater than 22 feet, deep well pumps are necessary. These consist of some type of driving mechanism at the ground surface, which operates a pumping mechanism placed in, or close to, the water in the well.

Regardless of the type of pump used, there are three systems for storing and supplying water to the outlets. These are the gravity system, the fresh water system, and the hydropneumatic.

GRAVITY SYSTEM

In a gravity system the water is pumped into an elevated open tank, from which it runs by gravity to the various outlets. The tank may be made of sheet metal, wood, or concrete. It is quite inexpensive, and should be of large capacity. This system is used mainly with windmill or gas engine operated pumps, hydraulic rams, or where a large quantity of water is needed for short periods, as in watering greenhouses. For warm-weather use, the tank is frequently placed on a tower in the open, but, unless it is carefully constructed and in continuous use in the winter there is a danger of freezing. For domestic supplies, where a very large tank is not necessary, the tank may be placed in the upper part of the house or barn where it is protected from frost. It is essential that the building be reinforced to carry

the extra weight. One Imp. gallon of water weighs 10 lbs., therefore a 500 gallon tank would contain $\frac{500 \times 10}{2000}$ which equals $2\frac{1}{2}$ tons of water. The

tank must have an adequate overflow to guard against flooding because of failure of the pump to shut off. Since the tank will usually be colder than the surrounding air, condensation of moisture (sweating) on the outside of the tank and subsequent dripping, may result in damage to structures below it. Damage from sweating may be reduced by placing the tank on a shallow pan drained to the outside, or by insulation. Tanks of from 200 to 500 Imp. gallons capacity are commonly used for domestic supplies, but larger ones are available for those cases where a large water consumption is expected.

Any common type of pump may be used with this system. It should be controlled by a float-operated switch to shut it off before the tank overflows. Air controls and pressure switches are not necessary.

Where a gravity system is used, adequate sized distribution piping is essential, as the maximum pressure at the taps may be as little as 3 lbs. per square inch. Half-inch pipe should not be used, except for very short lines supplying single fixtures and $\frac{3}{4}$ " pipe may be too small for the main distribution pipes.

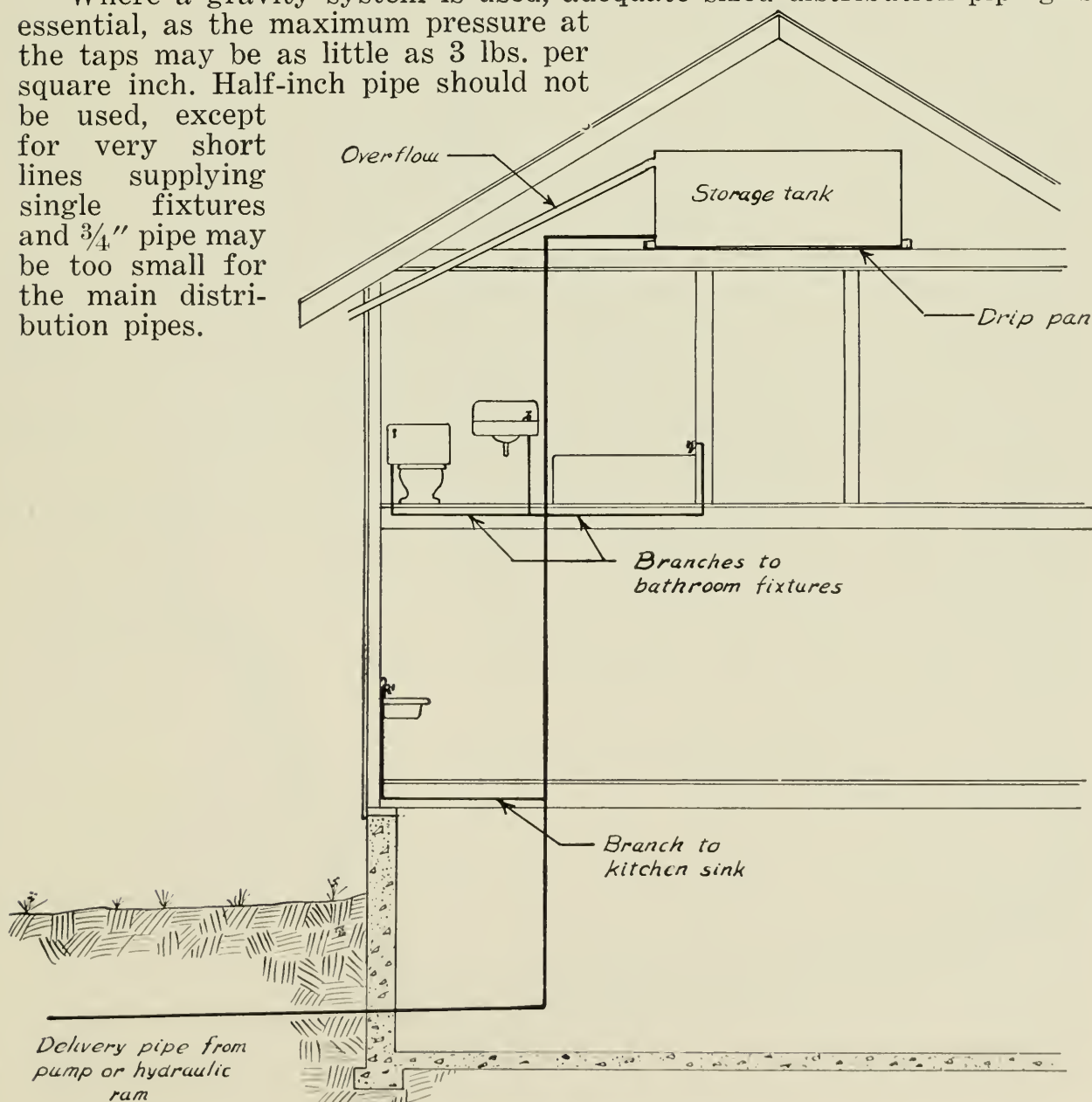


Fig. 8—Gravity Water System

HYDRAULIC RAM

Where a steady supply of flowing water is obtainable; usually from a spring, and some fall may be provided, the hydraulic ram may be used to pump a part of this water to a higher elevation where it is needed. The hydraulic ram uses the energy produced by water falling through a short distance to raise a part of that water to a greater height. No other source of power is required.

Since the hydraulic ram requires no outside source of power, it is particularly useful where electricity is unavailable, provided the following requirements are met.

1. Dependable flow of water of at least 2 gal. per minute (preferably 6 or more).
2. A fall from the water source to the ram of at least one-tenth the height to which the water is to be raised.
3. Good drainage for waste water away from the ram.

A typical hydraulic ram installation is shown in Fig. 9. The spring should be protected against entrance of surface water, as shown in Fig. 5. The drive pipe should be submerged 12" or more below the water level in the spring box, and should be run straight to the ram, with a gate valve at the lower end to permit shutting off the water if repairs are necessary. Do not use a globe valve, as it introduces too much resistance to the flow of water. The length of the drive pipe must not be less than 6 times the fall, or three-quarters of the lift, nor longer than ten times the fall.

The ram itself should be protected from frost, by being placed in a pit, or a frost-proof box, and should be securely bolted down.

The delivery pipe must be buried below frost level, and run at an upward grade as uniformly as possible. Both drive and delivery pipe should be of the size recommended by the manufacturer of the ram, or larger.

It is very important that the ram pit or house be drained to permit the escape of waste water.

Since a ram delivers only a small proportion of the water flowing through it, it is necessary to supply a reservoir to store water for peak consumption. The ram operates continually, hence is excellently suited to use with a gravity tank, which must be provided with an overflow to drain off surplus water. The tank should be of sufficient capacity to store the water needed for one day.

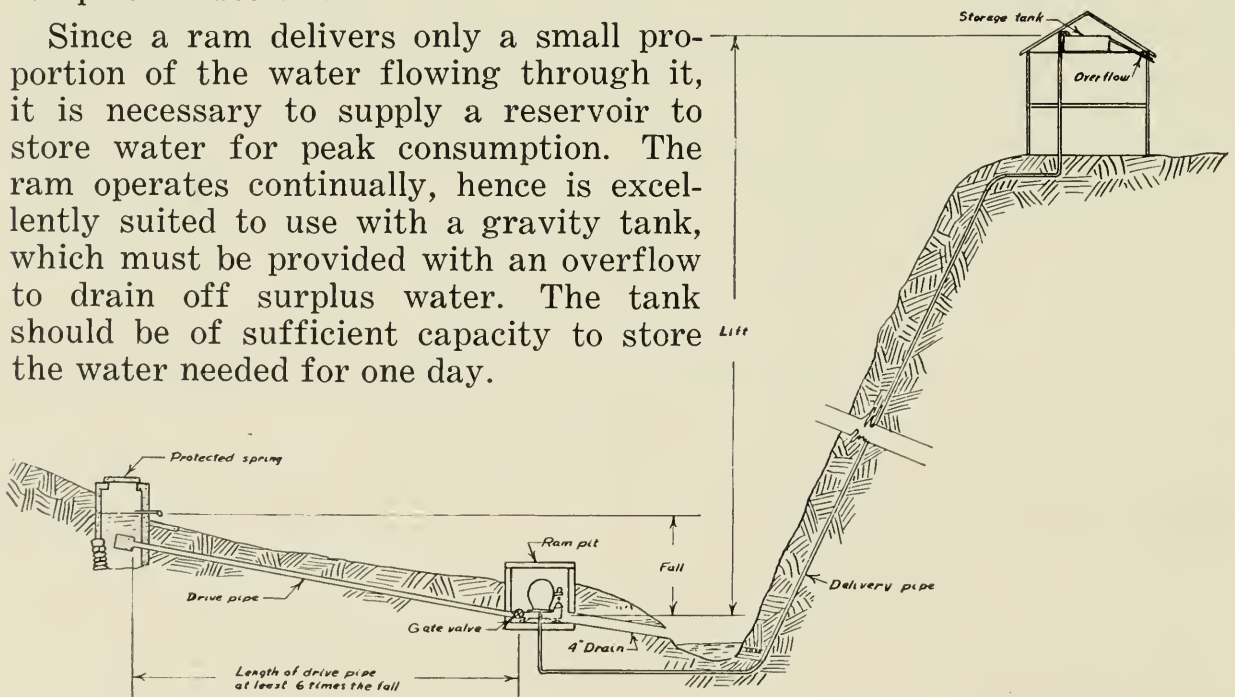


Fig. 9—A Hydraulic Ram Installation

FRESH WATER SYSTEMS

The fresh water system, as shown in Fig. 10, is an inexpensive installation for shallow-well use, consisting usually of a shallow-well reciprocating pump on which is mounted a small air chamber of 1 or 2 gallons capacity. No storage tank is used, the small tank acting chiefly as a buffer to absorb pulsations. Consequently whenever a tap is opened the pump must start delivering water directly from the well and stop when the tap is closed. Water can only be drawn at the rate at which the pump can pump it. If a small amount of water is being drawn, the pump will switch on and off alternately. This frequent starting and stopping is hard on both pump and motor.

This system is not recommended for permanent domestic installations, and should only be considered when first cost is an important factor, or for temporary installations such as at summer cottages.

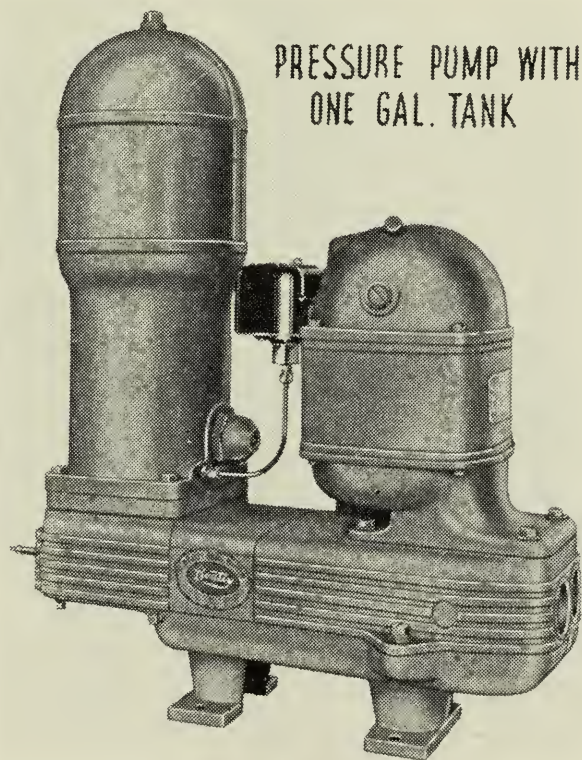


Fig. 10—Freshwater System
(Courtesy Beatty Bros. Ltd.)

HYDROPNEUMATIC SYSTEMS

Hydropneumatic systems, often called “pressure systems,” are usually the best type for domestic supplies where electricity is available. They may also be used with engine driven pumps. Water is forced into an air-filled tank, compressing the air above it, until the cut-out pressure is reached. When a tap is opened, the compressed air forces water out the delivery pipe near the bottom of the tank. The system is compact, and may be placed in the basement, pump house, or other building. The tank supplies a small reserve and ensures adequate pressure at the taps. The system may be entirely automatic, if electrically driven, requiring only periodical lubrication.

The pump is started and stopped by a pressure-operated switch, usually set to switch the pump off when the pressure reaches 40 lbs. per sq. inch and to start it again when the pressure drops to 20. This setting can be varied if necessary.

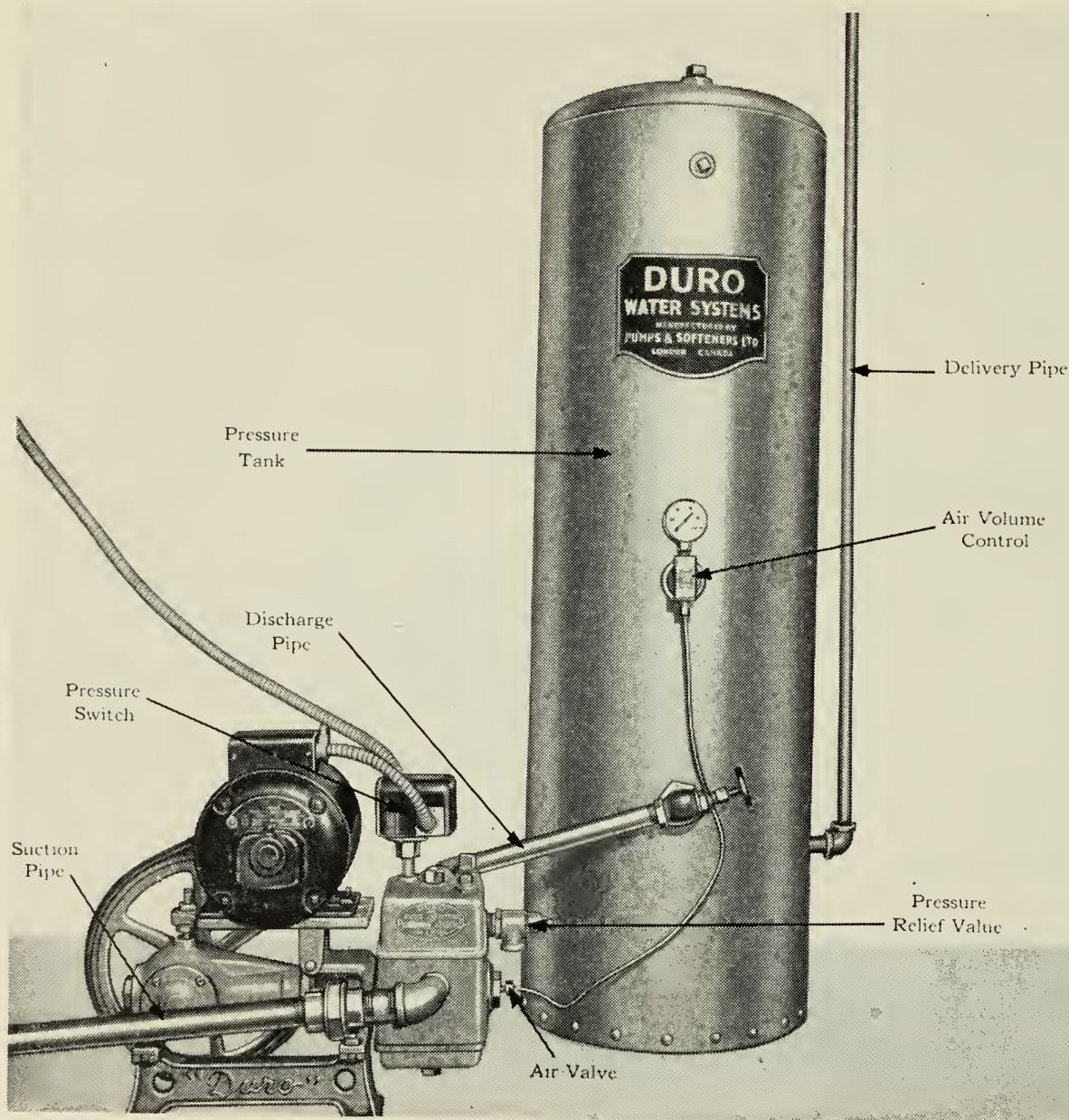


Fig. 11—Hydropneumatic System
(Courtesy Pumps & Softeners, Ltd.)

PRESSURE TANKS

Pressure tanks are usually of galvanized steel. Black iron tanks have a short life because of rust and corrosion and are not recommended. Standard tanks are designed for a maximum working pressure of 85 lbs. per sq. inch, but are seldom operated at pressures exceeding 40 lbs./sq. inch.

As, even at the cut-out pressure of 40 lbs. per sq. inch, a large part of the tank is taken up with air, and water which will not be delivered at working pressure, only a small portion of the tank provides active water storage capacity. This active storage is usually about $\frac{1}{7}$ of the total

capacity of the tank, when the cut-out pressure is 40 lbs./sq. inch and cut-in pressure is 20. If too much or too little air is present in the tank the storage will be less.

Because of the relatively small active storage capacity of hydro-pneumatic tanks it is seldom practical to use them where large sustained demands are expected, as in watering greenhouses, supplying sprayers, etc. However, they are the best system for most conditions, where water requirements are reasonably uniform.

Most small domestic units are equipped with 25 or 35 Imperial gallon tanks as standard equipment, but larger tanks are available. As a general rule the pressure tank should have a total capacity equal to ten times the pump capacity in **gallons per minute**. For instance, a 360 gallon per hour

pump will deliver $\frac{360}{60}$ equals 6 gallons per minute. Therefore, the tank

should be 10 x 6 equals 60 gallons total capacity.

In cases where the well supplies a very limited flow, a smaller pump must be used than the one usually recommended, and the tank must be larger.

AIR VOLUME CONTROLS

Maintaining the proper amount of air in the tank is essential for proper operation of the system. Air under pressure dissolves slowly in water; hence it is necessary to add air to the tank at intervals. To do this, most shallow well pumps are equipped with an air valve, which is similar in appearance to a tire valve.

In many old installations, and some new ones, the pressure tank is equipped with a gauge glass to show the water level. These units are not equipped with automatic air controls so it is necessary to check the water level periodically, and if it is too high, to remove the cap from the air valve, permitting the pump to force air into the tank, until the proper water level is reached. The valve cap must then be replaced. Since the water level in the tank varies with pressure, the level should only be checked when the tank pressure is 40 lbs. per square inch.

Many deep well systems, not equipped with an automatic control, have a separate air pump which can be disconnected from the drive. If the water level is too high the air pump should be connected, and allowed to operate. When the water reaches the proper level the air pump should again be disconnected. Consult the manufacturer's instruction book to determine the proper method.

Most of the new shallow well systems have an automatic air control installed on the tank. This is connected to the air valve on the pump, and automatically allows the pump to add air when the water level gets too high. These units are available for modernizing most old systems which are manually controlled.

It is essential that the tubing connections from the air control to the pump are leak-proof.

Most deep-well reciprocating pumps are equipped with a constant-running air pump. The air volume control must permit air to escape from the tank when the water level becomes too low.

Many centrifugal and centrifugal-jet pumps will not pump air, so are equipped with a special air volume control. One type consists of a small diaphragm pump connected with the pump suction line. When the pump starts, the diaphragm is drawn against a spring, sucking air into the air-control body. When the pump stops the spring forces the diaphragm forward forcing the air into the tank. Other types, working on a similar principal, which operate when water is drawn from the tank, are also used.

Failure of the air control may result in two conditions. **Water-logged tanks** result when insufficient air is entering the tank, with the result that active storage is reduced and the pump starts and stops frequently. With shallow well pumps this may be caused by stuck valves in the air control, plugged air line or intake, or a bent or leaky float. With deep well systems it may be failure of the air pump, or air control valves stuck open. A leak near the top of the tank may permit air to escape faster than it is pumped in, and will cause a similar effect. **Air bound tanks** occur when too much air is present in the tank, causing gushing of water and air at the faucets. This may be caused, in deep well reciprocating units, by an air release valve which is stuck shut, and in shallow well pumps by a leaking connection between the control and air valve, by a stuck valve in the control, or very often, by leaky plunger rod packings or a leak in the suction pipe.

PRESSURE SWITCHES

Electric pumps used in hydropneumatic systems are always controlled by a pressure actuated switch. These are preset at the factory, generally to start the pump when the pressure drops to 20 lbs. per sq. inch and to stop it when the pressure reaches 40. These settings may be varied if necessary, but this should not be attempted by anyone who is not familiar with the mechanism. Most positive acting pumps now have a built-in relief valve which opens before dangerous pressures are reached, in case the pressure switch should fail to operate.

A pressure switch is available for gasoline driven systems, which grounds the magneto. This stops the engine when the correct pressure is reached. It is necessary to start the motor manually.

ELECTRIC MOTORS FOR PUMPS

Many pumps have a heavy starting load. For this reason split phase motors, such as are used on washing machines, are not satisfactory, as they have poor starting characteristics. They are used on some types of pumps which have a light starting load. Most pumps are equipped with capacitor-start or repulsion-induction motors.

Pumps are equipped at the factory with the proper type and size of motor. If a replacement is necessary a reliable dealer or factory representative should be consulted.

SHALLOW WELL PUMPS

Modern shallow well pumps are compact, simple, and relatively inexpensive units, easy to install and operate. They are manufactured in various types and many capacities. They may only be used where the suction lift does not exceed 22 feet.

Reciprocating Shallow Well Pumps

This type is very popular for farm installations. They operate similarly to a hand pump, but deliver water on both strokes of the piston. They are made by most pump manufacturers, in sizes ranging from 150 gal. per hour up to several thousand. Different types are available, with belt or direct drive, one or more cylinders, and may be specially equipped for special uses. They can be driven by gasoline or other motors as well as electricity. A typical shallow well reciprocating pump is shown in Fig. 12. These pumps have the following characteristics:

Capacity depends on the size and number of cylinders, and number of strokes per minute.

Pump delivers almost uniform amount at all delivery pressures.

Discharge pressure is limited only by the power of the motor and construction of the pump. Pressures ranging from 40 to several hundred lbs. per sq. inch are possible.

Efficiency of the pump remains nearly constant regardless of capacity, discharge, or suction head.

They will handle water containing silt or sand in small quantities.

This pump is self-priming, and will pump air; however it is customary to prime it when first installed.

More maintenance is required than for many other types.

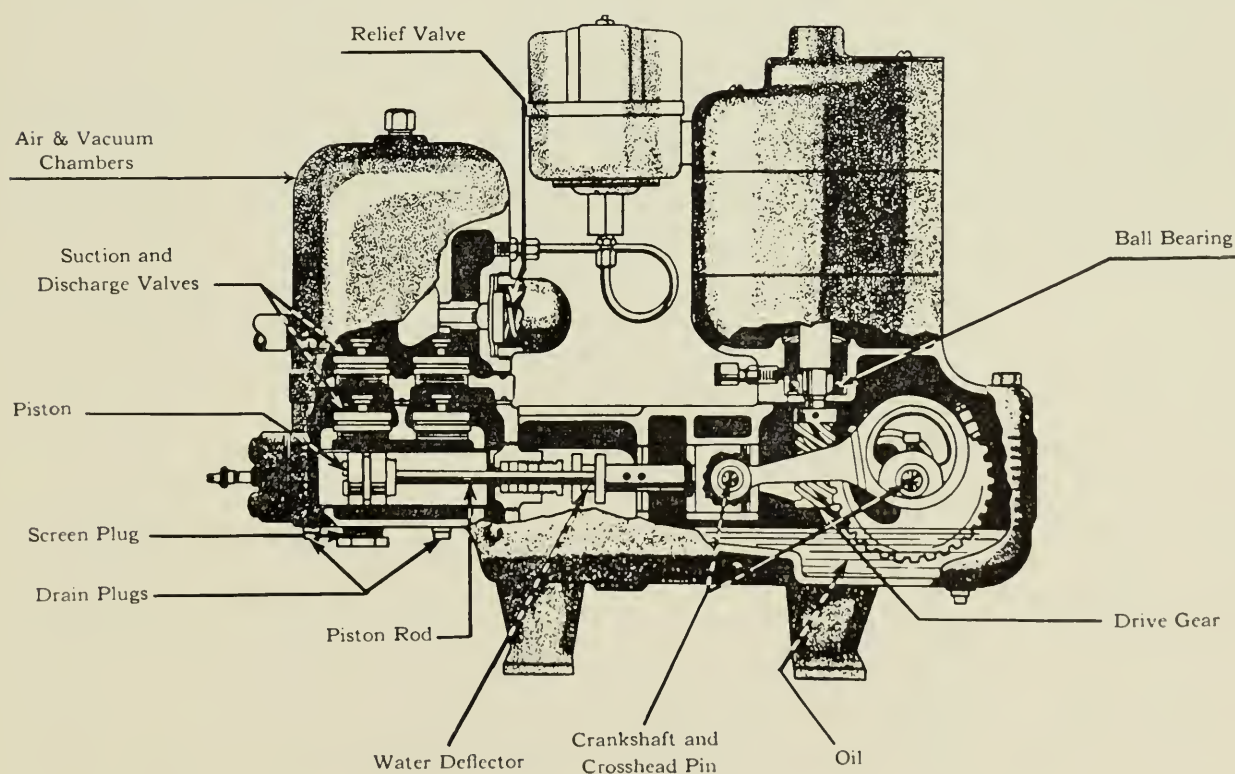


Fig. 12—A Reciprocating Shallow Well Pump
(Courtesy Beatty Bros. Ltd.)

Maintenance—Lubrication is accomplished by oil bath. The oil must be checked periodically and maintained at the proper level. Since some water may enter the oil reservoir because of leaky packings, it is very important that the oil be drained and replaced as the manufacturer recommends.

Plunger rod packings may wear and leak. They should be tightened, with the pump running, until the leak just stops. Do not over-tighten. Packings which are too tight will damage the shaft, and may overload the motor, causing it to burn out. If the leak cannot be stopped by tightening the packing nut, the packings should be replaced.

When replacing packings, remove the packing nut, then switch on the pump. Usually the old packings will be blown out by the pressure developed by the pump. Do not pry them out with sharp tools, as the shaft may be scarred so it will be impossible to keep packings tight. Usually 3 or 4 rings of packing are used. Replace them all.

Plunger leathers, cylinders, piston rods and valves will in time become worn and need replacing. Consult the manufacturer's instruction book or a reliable dealer for the proper procedure.

Centrifugal Pump

Centrifugal pumps are of simple construction, pumping water by the centrifugal force produced by a rapidly rotating impeller. Water is drawn in at the center of the impeller, and discharged off the ends of the impeller blades. Although they have been chiefly used where large volumes are required, several models especially designed for domestic water supply work are now available, and they are also used as the primary pumping mechanism in most jet pumps.

The characteristics of centrifugal pumps are as follows:

They are capable of high efficiency when used under the conditions for which the particular pump is designed.

This efficiency is greatly reduced when used under other conditions.

Capacity decreases rapidly as pressure increases.

Pump is not self priming.

Flow is continuous, non-pulsating.

Operation is quiet.

Unless of special design, this pump will not pump air.

If the impeller is of special design, will pump liquids containing large quantities of sand and silt.

As there is only one moving part, the impeller, very little maintenance is required.

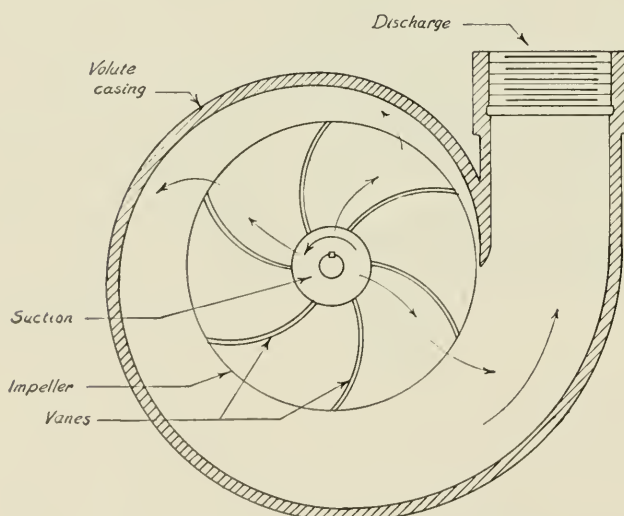


Fig. 13—A Centrifugal Pump

Centrifugal-Jet Pump

This consists of a centrifugal pump with a built-in injector. The jet increases both pressure and pumping depth of the centrifugal pump. Operation is similar to the deep well jet pump. A typical shallow well jet pump is shown in Fig. 14. The characteristics are as follows:

Capacity decreases as pressure increases.

Flow is non-pulsating.

Must be primed to start, but self-priming thereafter.

Will handle water containing sand or silt, or other materials.

Will work against high delivery pressure.

Requires little maintenance.

These pump are usually equipped with a water lubricated rotary seal which requires no lubrication or adjustment. When packing glands are used they should never be overtightened. Consult the manufacturer's literature for lubrication and adjustment.

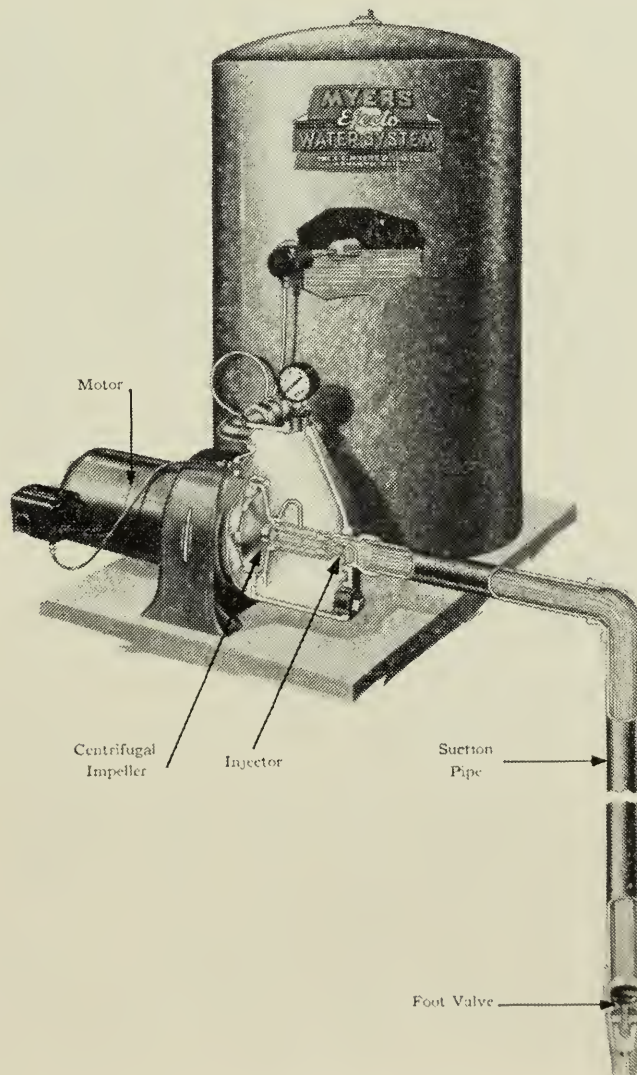


Fig. 14—A Shallow Well Jet Pump
(Courtesy F. E. Myers & Bro. Co.)

Turbine Pump

A shallow well turbine pump is similar in appearance to the centrifugal pump, but operates on a different principle. The impeller is a brass disc with many fine blades around the periphery, which forces water from inlet to the discharge. The construction is shown in Fig. 15.

The characteristics of the turbine pump follow:

Uniform, non-pulsating discharge.

Quiet, vibrationless operation.

Capacity decreases as pressure increases.

Very close clearances make this pump very subject to damage by sand in the water.

Not self-priming, but will pump air.

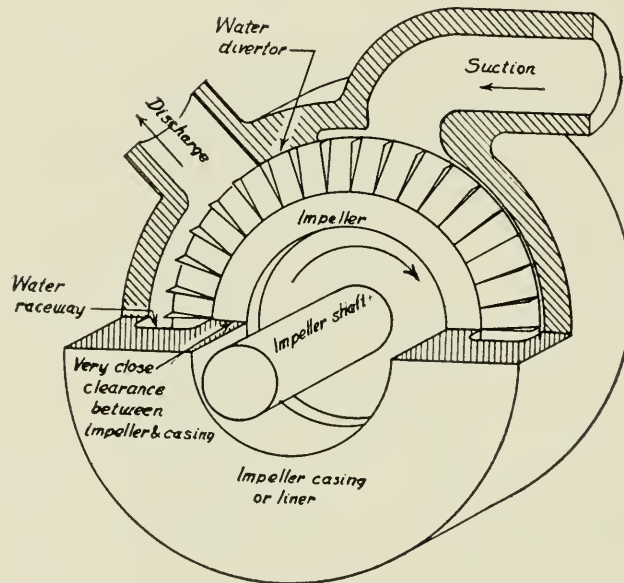


Fig. 15—A Shallow Well Turbine Pump

Helical Rotor Pumps

Helical rotor pumps consist of a helical metal rotor rotating inside a rubber stator, pumping water by a “progressing cavity” effect. Such a pump is shown in Fig. 16.

The characteristics are very similar to those of reciprocating pumps, but the flow is not pulsating. Little maintenance is required. It is important that the pump be filled with water before operating, as water is essential for lubrication.

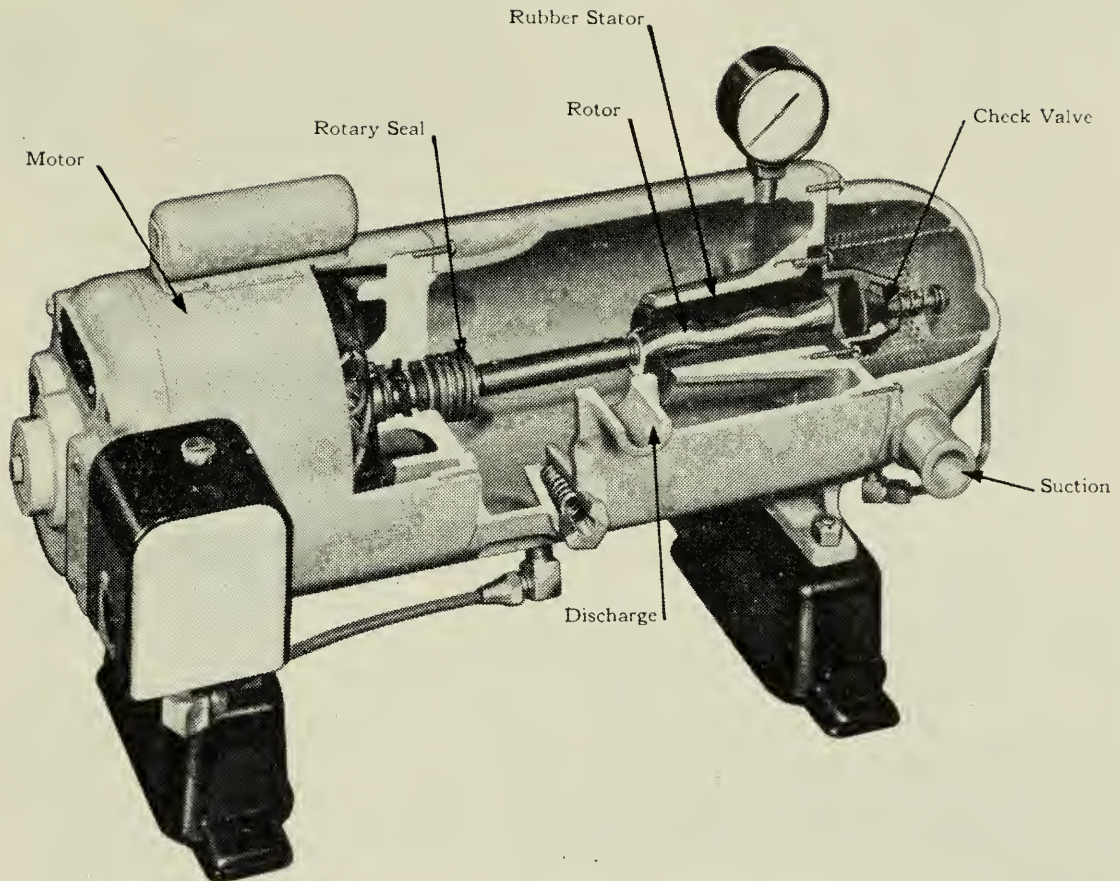


Fig. 16—A Helical Rotor Shallow Well Pump
(Courtesy The Robbins & Myers Co. of Canada, Ltd.)

Rotary Gear Pumps

Rotary pumps depend for their operation on the rotation of a pair of gears inside a close fitting housing. The fluid is carried from intake to outlet in the spaces between the gear teeth and the housing. As the gear must fit the housing very accurately this type of pump should never pump water containing sand or silt. The pump depends for its lubrication on the liquid being pumped. Consequently, no rotary pump should be used for water supply unless it is specifically designed for that purpose. Unless well made they tend to be noisy.

Characteristics are as follows:

Positive discharge — Capacity almost constant regardless of pressure.

Maximum suction lift 22 feet.

Self-priming, but should be primed to start. The fluid pumped is necessary for lubrication, hence they must not be run dry.

Will not pump water containing sand or silt.

Non-pulsating flow.

As designs of these pumps vary considerably the manufacturer should be consulted as to suitability for water supply work, lubrication, and adjustment.

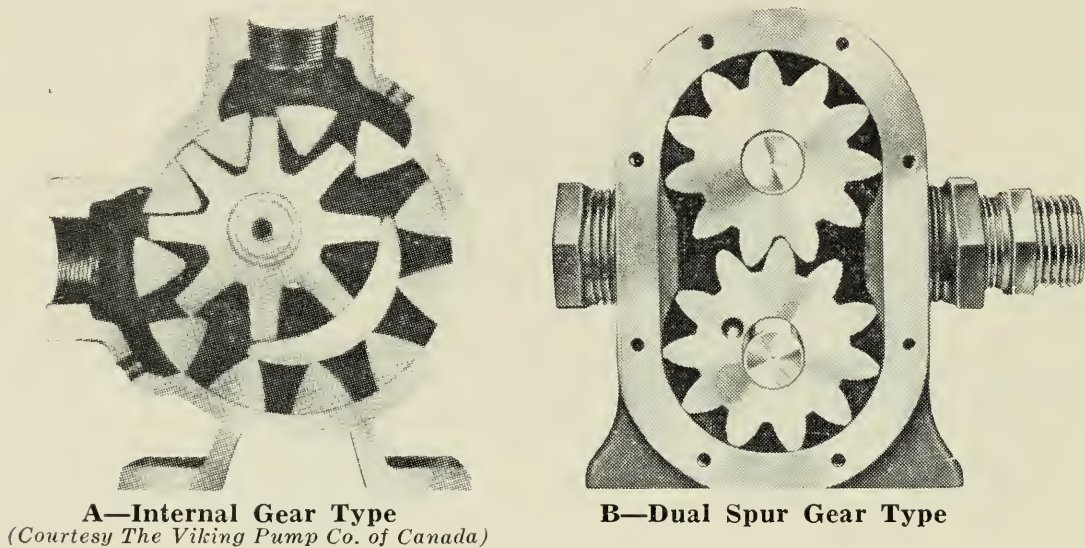


Fig. 17—Gear Pumps

Shallow Well Pump Installation

As the shallow well pump need not be placed over the well, it is possible to install it in a basement or barn. The location chosen should not be far from the well, should be clean and dry, easily accessible, and frost-proof. Usually the house basement meets these requirements. The pump should be placed on a raised concrete platform, several inches above the floor, and securely bolted down.

The suction line should be of galvanized pipe, laid in a trench deep enough to be safe from freezing, and connected to the pump by a union to make disassembly easy. It should be run as straight as possible from the pump to the drop-pipe in the well, with a slight slope downward toward the well. The drop-pipe should be long enough that the lower end will always be underwater. A foot valve on the end will assist in holding the prime.

It is important that the suction line be at least as large as, if not larger than, the suction tapping of the pump. When suction lifts approach 22 feet and the distance from the pump to the well is over 80 feet, the drop-pipe and horizontal suction pipe should be one size larger. Where a shallow well pump draws water from a cistern, with the pump below the cistern water level, the water in the "suction" pipe is always under pressure. This may result in a reciprocating pump pounding, and air valve will not operate. In such cases a gate valve should be installed between the cistern and the pump. With the pump running the valve should be gradually closed until the pounding stops and air is sucked in through the air valve. Once set, this valve need not be touched.

In laying the pipe the threads should be carefully made and leaded, the burrs reamed out, and the couplings tightened snugly. Do not fill the trench until the pump has been run, and the pipe checked for leaks which will permit air to enter the water and possibly cause loss of prime.

The pressure tank is usually placed close to the pump and connected to it with as few elbows and other fittings as possible. If the tank must be some distance from the pump, or a number of fittings must be used to connect the two, the pressure switch should be installed on the tank.

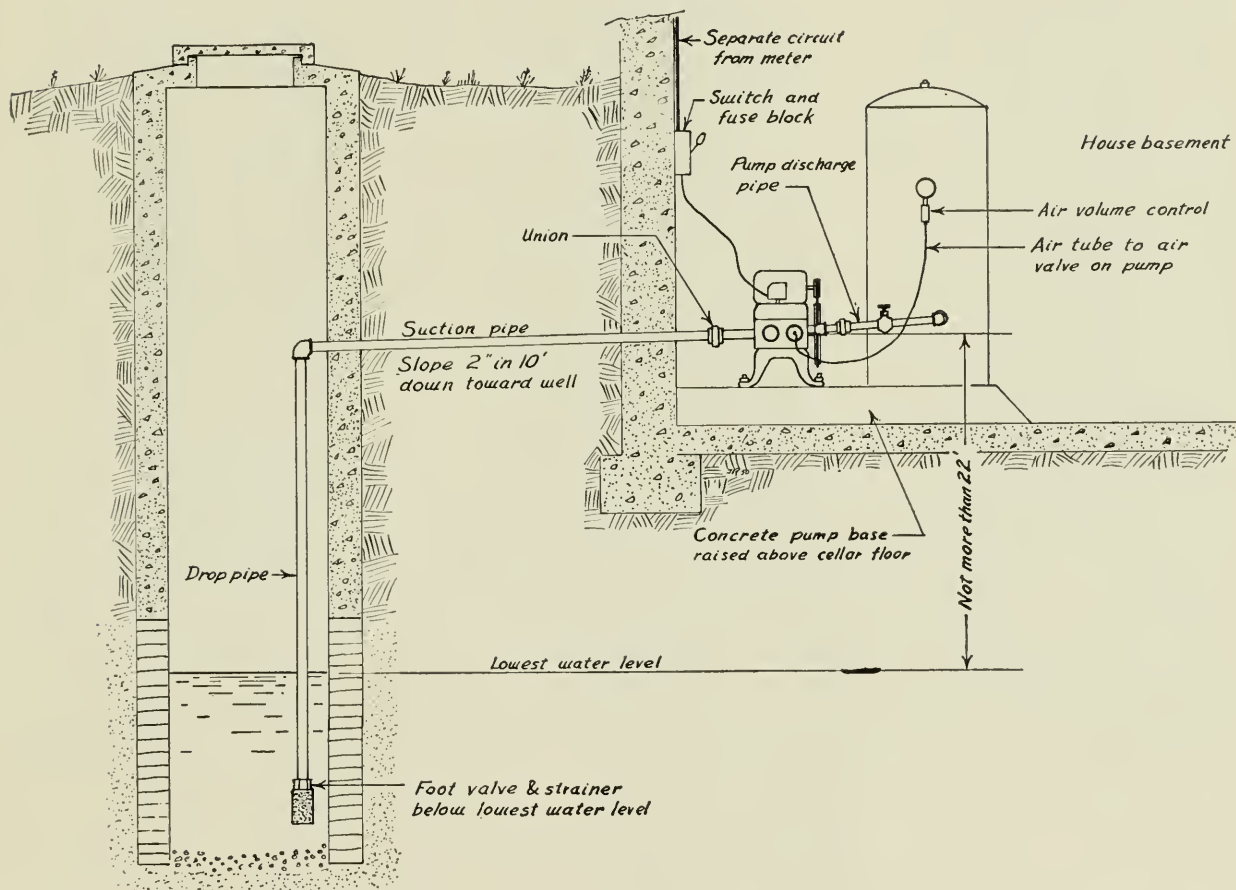


Fig. 18—Shallow Well Pump Installation

DEEP WELL PUMPS

Deep well pumps must be used where the vertical distance from the water surface to the pump location is more than 22 feet.

Reciprocating Deep Well Pumps

These pumps consist of a motor and driving mechanism which must be placed over the well, operating a cylinder in or near the water by means of rods, similar in action to the common windmill or set length pump. The pump rods may be of solid steel, hollow steel, or wood. Wood and hollow steel rods are preferred for great depths. Fig. 19 shows a typical deep well reciprocating pump.

These pumps are available in various capacities, for depths up to several hundred feet. Capacity is dependent on the size of cylinder, length of stroke, and number of strokes per minute.

Flow from this type of pump is pulsating, and horsepower requirements are higher than for the jet pump at moderate depths.

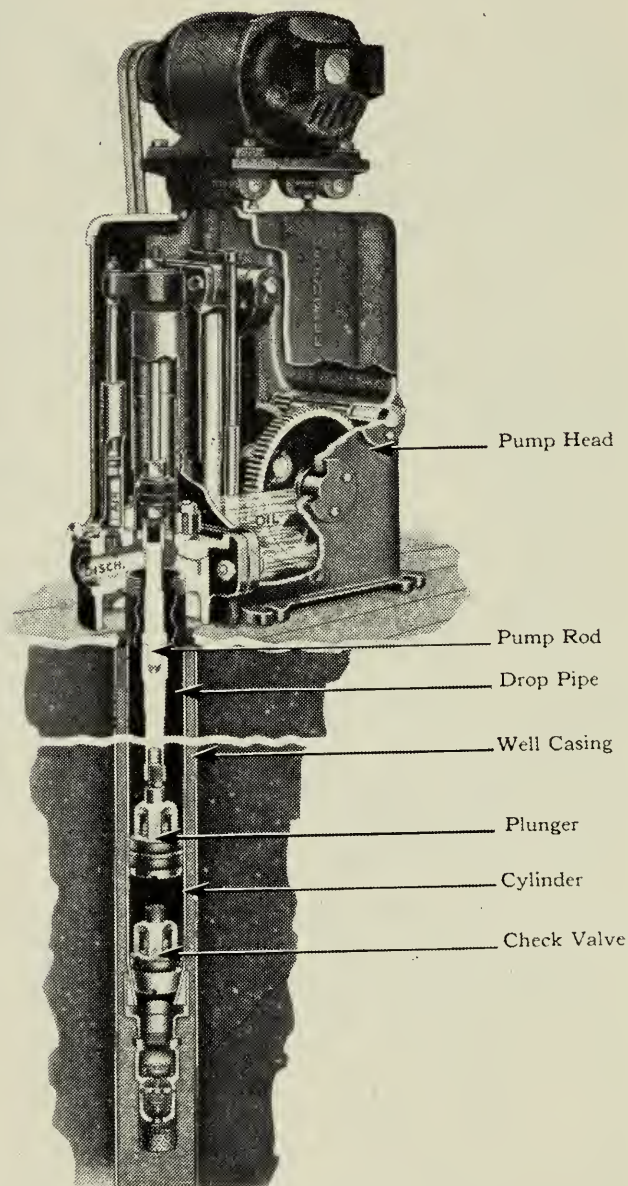


Fig. 19—Deep Well Reciprocating Pump
(Courtesy the R. McDougall Co. Ltd.)

Types of Cylinder

Two main types of cylinder are available—single acting and double acting. Because of the high cost of double acting cylinders they are seldom used.

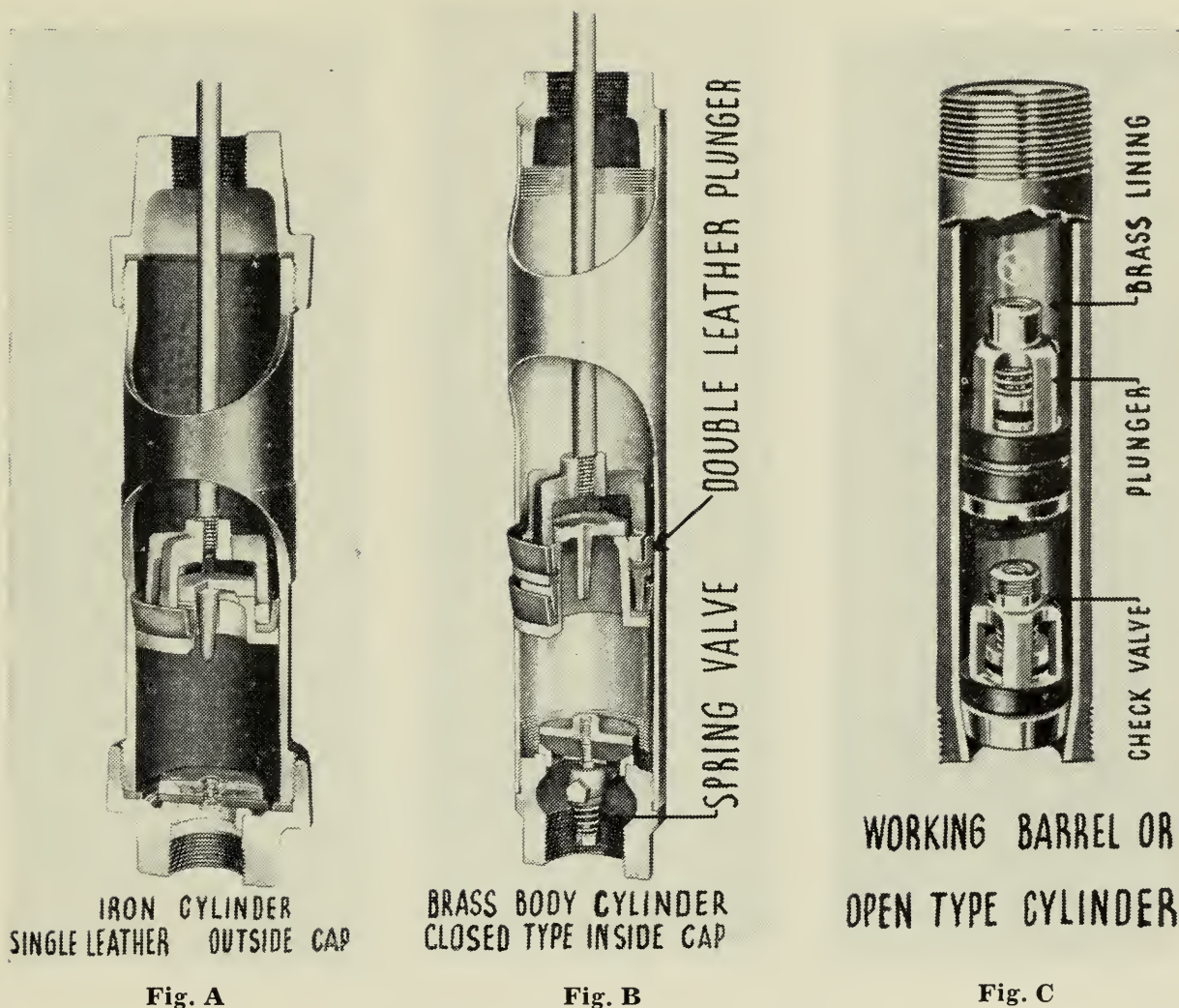


Fig. 20—Deep Well Cylinders
(Courtesy Beatty Bros. Ltd.)

Single Acting Cylinders

These are available in several types. Outside cap cylinders of iron or brass-lined iron are inexpensive, but are not recommended for power operated systems, because of their bulk and short life.

Brass cylinders with inside caps are commonly used where it is necessary to get a large capacity from a small diameter well. The chief disadvantage is that the drop-pipe and cylinder must be removed from the well when repairs are necessary.

Open cylinders are most convenient, especially for extremely deep wells. These are brass-lined, of slightly smaller inside diameter than the drop-pipe. Thus the plunger can be removed for repairs without disturbing the cylinder or drop-pipe. The check valve also is removable by screwing the plunger down onto it. This type of cylinder does not have the capacity of the brass inside-cap cylinder, and is more expensive.

Eureka cylinders are available for small diameter wells. These consist of a brass cylinder with a rubber packing which expands to form a seal between the cylinder and well casing. No drop-pipe is required. The plunger and check valve can be removed without disturbing the cylinder.

Tubular well cylinders, also for small diameter wells, form a part of the casing, so must be installed when the well is drilled. The use of these cylinders is described on Page 8 under Tubular Wells.

Plungers and Valves

Various types of valves and plungers are used in single-acting cylinders. Two or more leathers are used on the plunger, with as many as four for very deep wells or where high delivery pressures are required.

Poppet, spool or ball valves are available for various applications. Usually spring controlled poppet or spool valves are most efficient, but, because of their durability, ball valves are used in very deep wells or where conditions are very severe.

Double Acting Cylinders

Due to their higher cost, double acting cylinders are seldom used, except where it is necessary to obtain maximum capacity from a well. They pump on both the up and the down stroke. This makes it necessary to use rod guides or rectangular wood rod to prevent the rod from buckling on the down stroke.

Installation

All deep well reciprocating pump heads must be installed directly over the well. The drop-pipe and cylinder should be installed first, and sealed to the top of the casing. If an open cylinder is used the plunger and check valve need not be installed before assembling the drop-pipe. The pump head should be set in place on a firm concrete foundation raised above the floor of the pump-house or pit and connected to the drop-pipe and pump rod.

As this type of pump must be installed directly over the well, some method of frost protection is necessary. This is usually done in one of three ways.

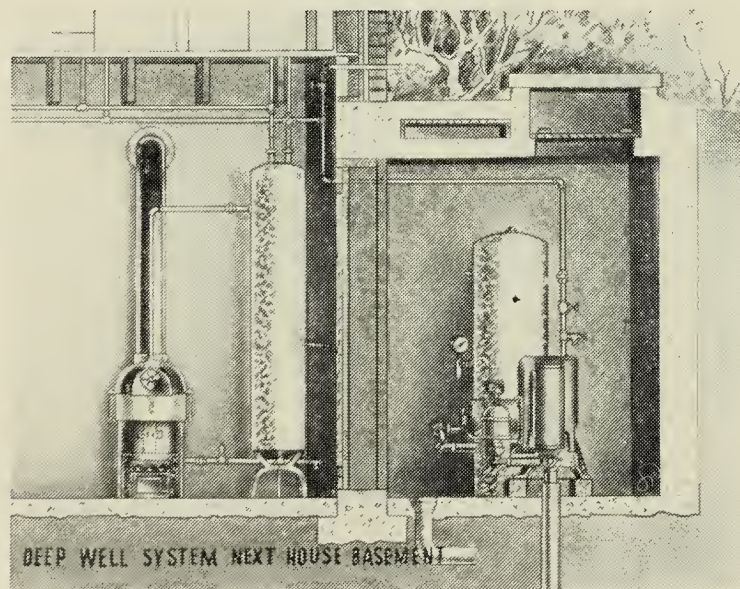


Fig. 21—A Basement Annex Installation
(Courtesy Beatty Bros. Ltd.)

Basement Annex

Where a new well is to be drilled it is frequently possible to locate it within a few feet of the house basement. A pit may be dug, connected to

the basement, in which the pump head is installed. The pump is easily accessible for lubrication, and well protected from frost. This type of installation is shown in Fig. 21. It is essential that the pump pit floor be above the basement floor, to eliminate danger of water accumulating around the pump, and that the pump pit roof be well insulated. A hatch should be left in the roof directly over the well to facilitate removal of pump rod or drop-pipe when repairs are necessary.

Set-length Pit Installation

Deep well reciprocating pumps are available for set-length installation, in which the water carrying parts are suspended several feet below the working head. This permits the pump head to be placed at the surface where dampness will not damage the motor, and the water carrying parts to be in a frost-proof pit. Such an installation is shown in Fig. 22.

It is essential that the pit be drained to a surface outlet, and that the opening between the drop-pipe and casing be properly sealed. The tank may be placed in the pit.

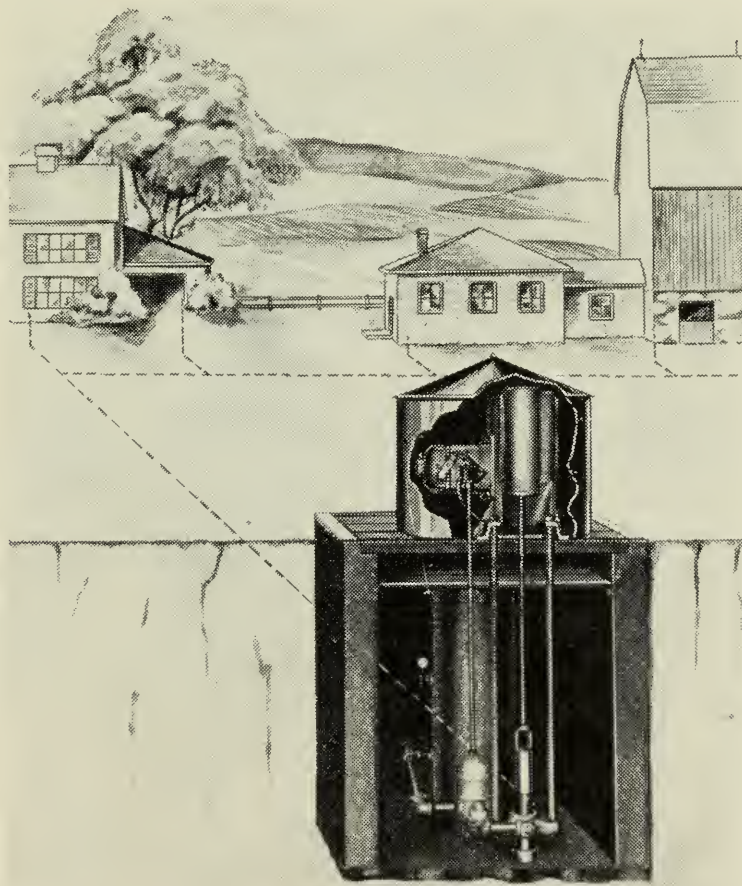


Fig. 22—Set-length Installation
(Courtesy Beatty Bros. Ltd.)

Surface Pump House

A well-insulated pump house may be built over the well, to protect the pump and tank from frost, where the pit installation cannot be used because of danger of flooding. The pump house should be as small as possible consistent with ease of servicing, and should be tightly built, insulated all round with 4" of shavings or rock wool. A heavily insulated door, or

double doors, should be used. A hatch should be left in the roof to permit removal of pump rod or drop-pipe.

If added protection is needed, a thermostatically controlled heater may be added, or a light-bulb left burning in the pump house in cold weather.

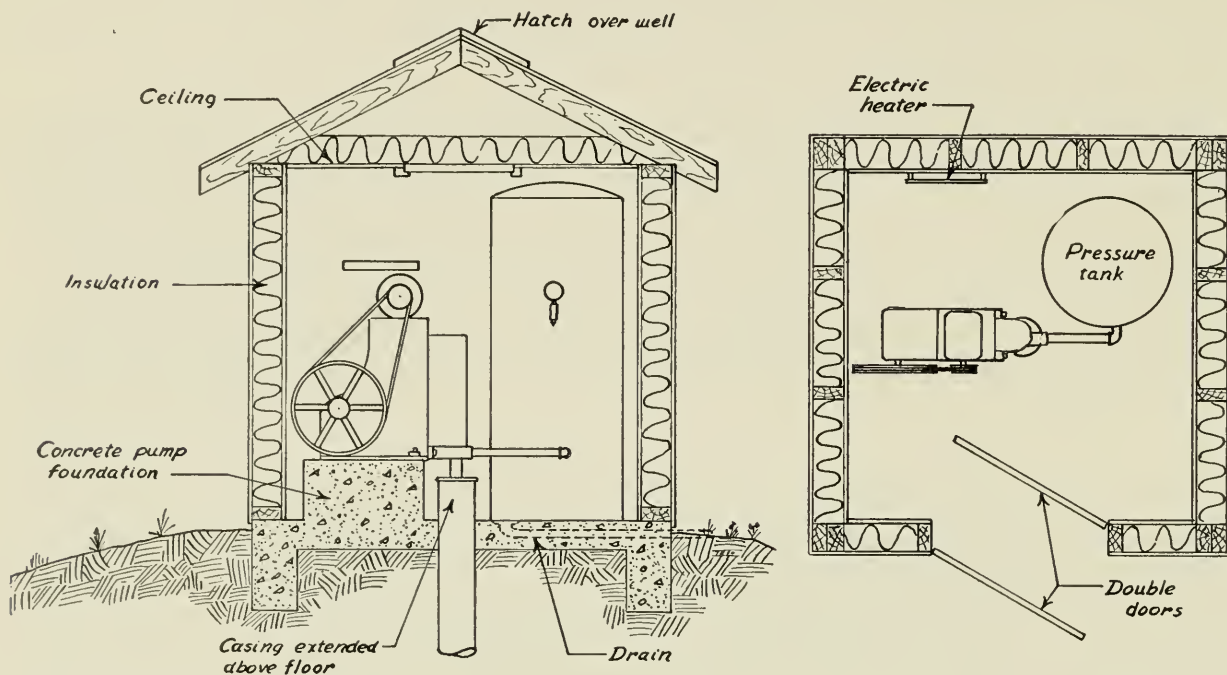


Fig. 23—Pump House Installation

Maintenance

Most deep well reciprocating pumps are equipped with oil bath lubrication. The manufacturer's instructions should be followed for changing and replacing the oil.

As with all piston type pumps, leathers and valves will eventually become worn and need replacing. If the pump is equipped with an open cylinder, it is merely necessary to withdraw the pump rod and replace plunger leathers. To withdraw the check valve, lower the pump rod until the plunger rests on the check valve, rotate the rod to the right a few turns, thus screwing the plunger down onto the check valve, then withdraw the assembly.

With closed cylinders it is necessary to pull the drop-pipe and remove the end caps from the cylinder to get at the plunger and check valve.

Deep Well Jet Pumps

These consist of a shallow well pump, usually centrifugal, located at the surface near the well, which returns part of the water pumped to an ejector placed below the water level in the well. Water returned to the ejector is forced through a nozzle at high velocity, where it mixes with water from the well and forces it up within suction distance of the pump. A foot valve below the injector is the only moving part in the well. Two pipes are required between the pump and ejector, a "drive-pipe" carrying

water under pressure to the ejector, and a "suction pipe" carrying water from the ejector to the pump.

Two types of injector assembly are available. The two-pipe assembly is for use in wells of four-inch or greater diameter. The single pipe assembly, for smaller diameter wells, is sealed into the casing, with the space between the single pipe and the casing used instead of the second pipe.

Characteristics of the jet type deep well pump are:

Pump need not be placed over the well — it may be set in a nearby basement.

The centrifugal pump is quiet running, and usually requires no attention for oiling.

The capacity decreases as lift and discharge pressure increase.

It is the most efficient type of pump for farm installation where the depth to water is between 22 and 70 feet, and will operate satisfactorily at depths of 100 feet or more.

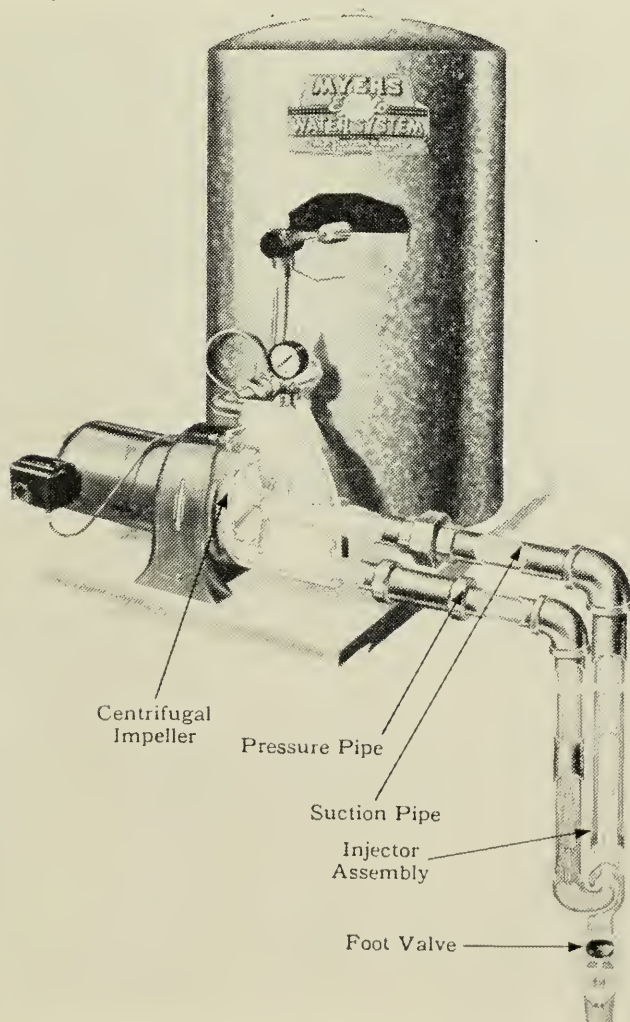


Fig. 24A

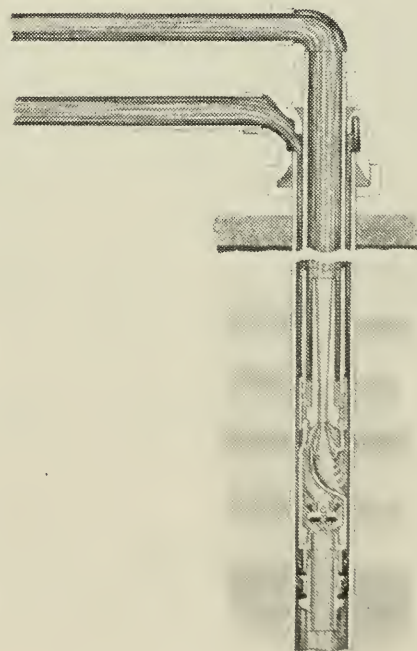


Fig. 24B

Fig. 24—A Deep Well Jet Pump
(Courtesy F. E. Myers & Bro. Co.)

Installation

Installation of deep well jet pumps is generally similar to that of shallow well pumps except that two pipes are necessary from the pump to the well. The ejector assembly should, if possible, be located below the lowest water level in the well. Special seals are available to seal the space between the casing and the two pipes. Fig. 25 shows a typical deep well jet pump installation.

The pump is tapped for the smallest recommended size of suction and drive-pipes. Never use smaller sizes than these tappings. If the distance from the well to the pump is very great these pipes should be one size larger.

Various ejector assemblies are available, depending upon the depth to water. When ordering, be sure to specify the depth of the well, so the proper ejector will be supplied. Use of the wrong ejector unit will result in inefficient operation or complete failure.

All jet pumps must be primed before starting. The pump should be operated before the pipes are covered, to be sure that there are no leaks.

Various methods are used to divert the proper proportion of water to the ejector. This adjustment should be made after the pump is installed. Check the manufacturer's instruction book for the proper method.

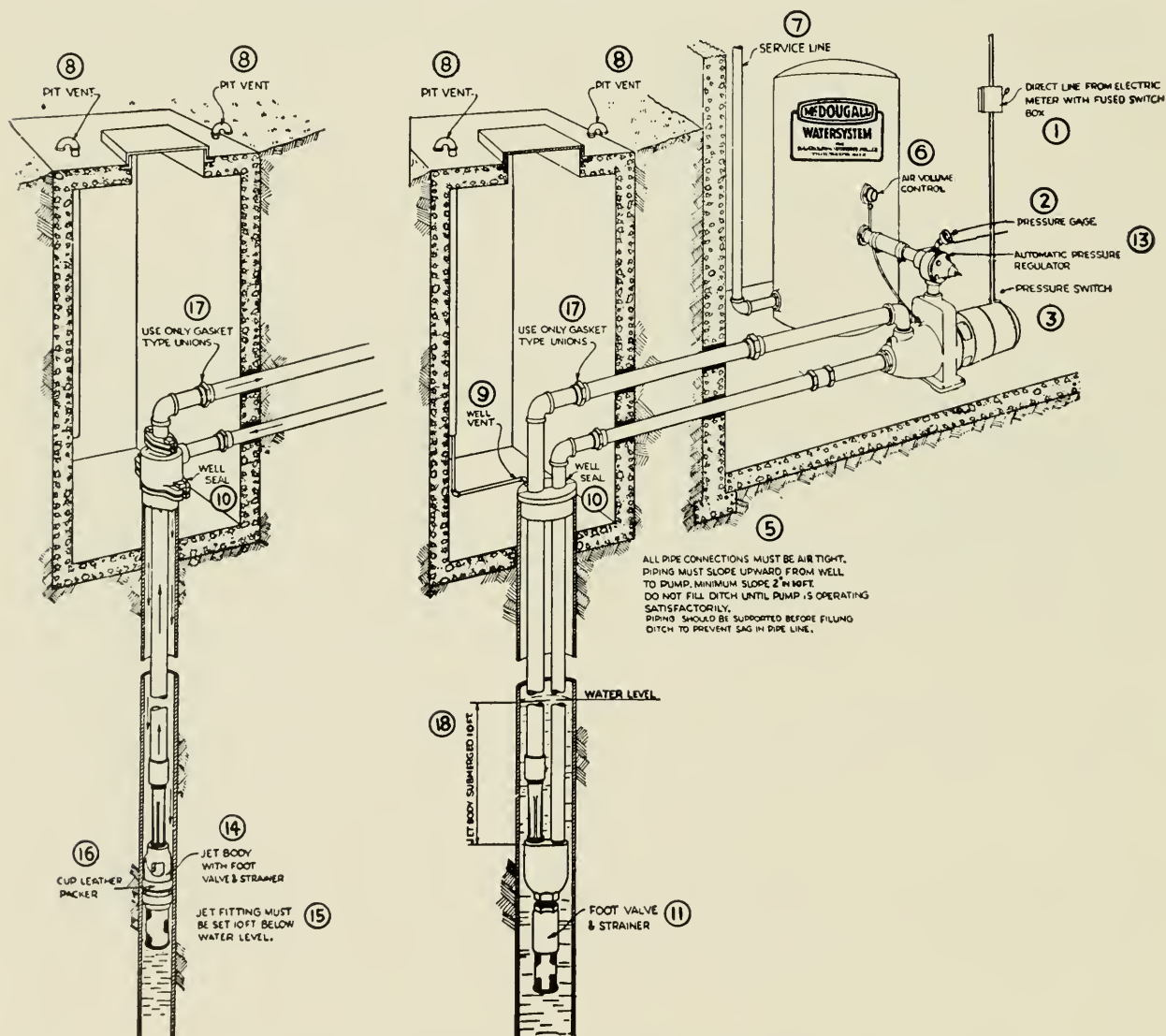


Fig. 25—A Deep Well Jet Pump Installation
(Courtesy the R. McDougall Co. Ltd.)

Maintenance

Most jet pumps are equipped with rotary shaft seals, which require no adjustment or lubrication. Others have water lubricated glands, which must not be tightened so far that all leakage is stopped. The manufacturer's instructions should be consulted for proper methods of lubrication and adjustment.

Deep Well Turbine Pumps

These are generally of higher capacity than those required for farm use. They consist of a series of small centrifugal pumps placed in the well, driven by a vertical shaft from a motor over the well. Their chief uses are for industrial and municipal supplies, and for irrigation.

Deep Well Helical Rotor Pumps are similar to shallow well helical rotor pumps, except that the pumping mechanism is placed in the well, driven by a shaft from the surface-mounted motor.

SELECTING THE PROPER PUMP

Two factors must be considered when selecting a pump; the type of pump and the capacity. The chief consideration as to type is whether it should be a deep well or a shallow-well pump. This is covered on Page 12. If a shallow well pump will operate, any of the types mentioned may be used. Where a deep well pump is necessary, either the jet or reciprocating type may be used. Generally the jet type is preferable for depths up to about 70 feet, but it will operate as deep as 100 feet, and has the advantage that it need not be placed directly over the well. Where the depth to water is 100 feet or greater, a reciprocating deep well pump should be used unless the volume of water required is sufficient to make the use of a deep well turbine or helical rotor type profitable.

The capacity of the pump will be determined by two factors; the amount of water required per day, and the capacity of the well. Where well capacity is ample, the pump size can be calculated from the daily water requirements, as determined on Page 1. The total daily water requirements should be divided by 3 to get the capacity of the pump in gallons per hour.

For instance, for the farm in the example on Page 1 requiring 765 gallons per day, the pump capacity should be $\frac{765}{3}$ equals 255 gallons per hour.

This will allow the pump to provide the daily water requirement in 3 hours' pumping time, resulting in longer life and less wear on the pump than when a smaller size is used.

Where the rate at which the well can supply water is limited, a pump with a capacity somewhat less than the amount the well can supply per hour, should be selected, and a large storage tank provided to take care of peak demands.

WATER HEATERS

Several types of water heaters are available. The most important for farm use are range boilers, side arm heaters, and automatic electric or gas heaters.

RANGE BOILERS

Where a coal or wood range is used for cooking all year around, a range boiler is a satisfactory method of heating water. When the range is only used in the winter, the range boiler may still be used, but a supplementary heater, usually of the side arm type, should be provided for summer heating.

A range boiler is low in first cost, consisting of an uninsulated galvanized tank of about 30 gallons capacity, connected to a heating coil or waterfront in the firebox of a range or furnace. As the water in the waterfront heats, it rises, allowing cool water from the bottom of the tank to take its place. Since this circulating action is weak, it is important that the tank be placed close to the source of heat, and connected to it by adequate sized pipe with a minimum of elbows and other fittings.

Range boilers are seldom insulated, as heating is nearly continuous, and some heat loss is desirable to prevent overheating with boiling and possible damage resulting. A safety valve should be installed in the hot water line close to the tank to permit the escape of steam in the event that pressures should become dangerous.

Fig. 26 shows a properly connected range boiler. The cold water connection must be made at the top of the tank to eliminate danger of draining the tank if the pump should fail. The cold water is carried downward through an internal pipe which has a small hole near the top to prevent any syphoning action.

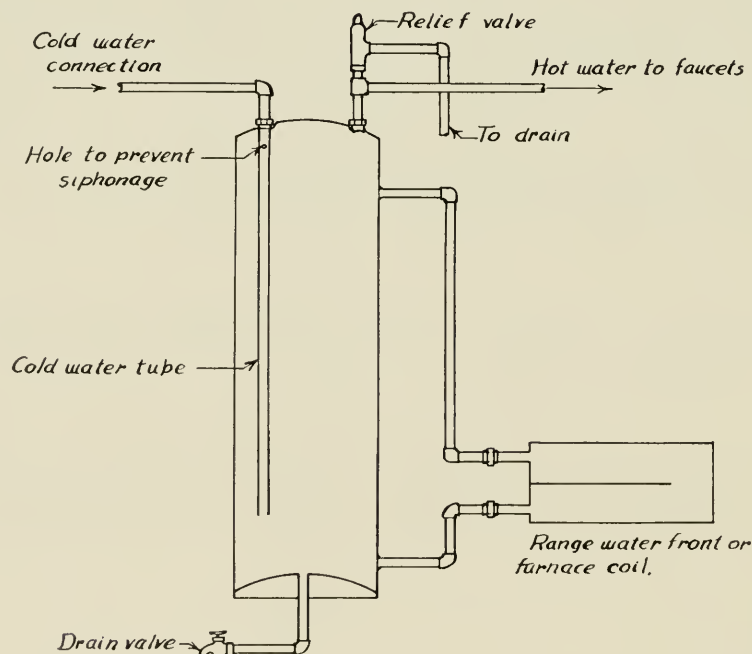


Fig. 26—Range Boiler Connections

SIDE ARM HEATERS

These are heaters designed to attach to range boilers or similar tanks. They consist of a water heating coil with some source of heat, usually gas, bottled gas, or kerosene. They are relatively low in first cost, but less efficient and convenient than automatic heaters. They are also likely to overheat if not properly operated.

Jacket heaters burning coal or wood are also available, but are less convenient because of the necessity of tending an extra fire if continuous hot water is needed. These heaters are connected in the same manner as the waterfront shown in Fig. 26.

AUTOMATIC WATER HEATERS

The most satisfactory type of heater is the automatic gas or electric water heater. Gas heaters may be operated by natural or manufactured gas, or by bottled gas. Electric heaters, however, are in more general use on farms.

Electric heaters consist of a storage tank, generally of about 30 gallon capacity, well insulated, heated by a thermostatically-controlled element placed near the bottom of the tank. Five hundred watt or 1000 watt heating elements are most commonly used. A 1000 watt heater will heat about 40 gallons of water per day from 60 to 160°F. The thermostats may be set to maintain water temperatures between 150 and 180°F.

As a single 500 or 1000 watt heater heats water rather slowly, a booster heater is frequently used near the top of the tank to provide more rapid heating.

Farm water heaters may be operated on a flat-rate for power. The electricity used to operate the main heater (not the booster) does not

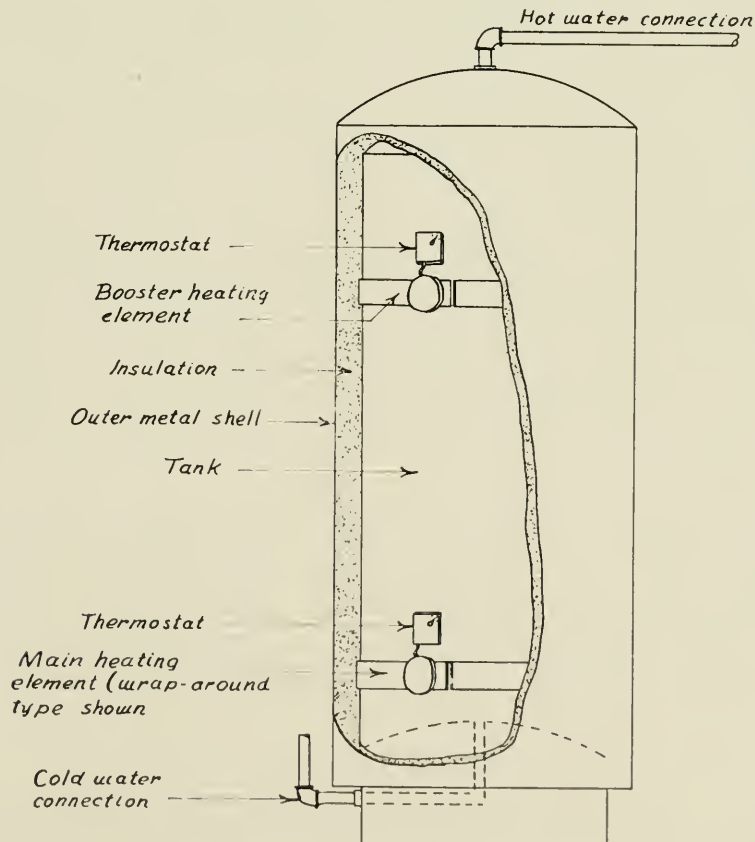


Fig. 27—An Automatic Electric Heater

pass through the meter, but is paid for at a monthly rate depending on the wattage of the element. Electricity for booster elements is metered. In order to be eligible for the flat rate the heater must meet hydro approval in respect to wiring, construction, and insulation, and the heater must be thermostatically controlled.

Two types of elements are used. The immersion element, which extends into the tank and is surrounded by water, is very efficient, but if hard water is used may become limed to the point where it will burn out. The wrap-around type, which fits around the outside of the tank, is less likely to be troubled by scale, therefore is better adapted to use in hard water areas.

Electric heaters are usually located near sink or bathroom, to reduce the heat loss in the pipes. They should be installed on a separate electrical circuit.

WATER TREATMENT

WATER SOFTENERS

The water in use in Ontario farms is of varying degrees of hardness. Hardness is caused by calcium, magnesium, or iron salts in the water. These prevent soap from lathering, form a curd or scum which causes bathtub rings and a dingy appearance to laundry, and cause scale to form on kettles, and heaters.

The disagreeable effects of hard water may be eliminated by the use of a softener, which not only provides soft water for laundry and washing, but also water fit for drinking or cooking.

Water softeners consist of a tank containing a mineral or synthetic material called a zeolite, through which the water passes. This zeolite is able to take up calcium and magnesium, which are the causes of hardness, from the water, releasing sodium, which does not cause hardness. Thus the water from a softener contains sodium salts instead of calcium or magnesium salts and is soft.

Zeolites have only a limited capacity for absorbing calcium and magnesium so eventually the softening action will become less efficient. Regeneration is then necessary. This is accomplished by adding a solution of common salt, sodium chloride, which reverses the softening process, replacing the calcium and magnesium in the zeolite with sodium ions from the salt. The released calcium and magnesium salts, and excess common salt, are flushed out with clear water, and the softener is again ready for operation.

The more expensive softeners are equipped with a brine tank which will hold enough salt for several months. Regeneration is simplified by valves, either manual or automatic, which add the proper amount of brine allow it to remain in the softening tank for the proper time, then flush out the excess salt. Due to the great variation in regeneration controls it is necessary to consult manufacturer's instructions for the proper procedure.

A less expensive type of softener, which does not have the brine tank, is also available. At each regeneration the cover of the softening tank must be removed and the correct amount of salt added. Hand valves are used for controlling backwashing and flushing. This type of softener

does as good a job of softening as the more expensive type, but regeneration is so much less convenient that it is not recommended in spite of the considerable saving in first cost.

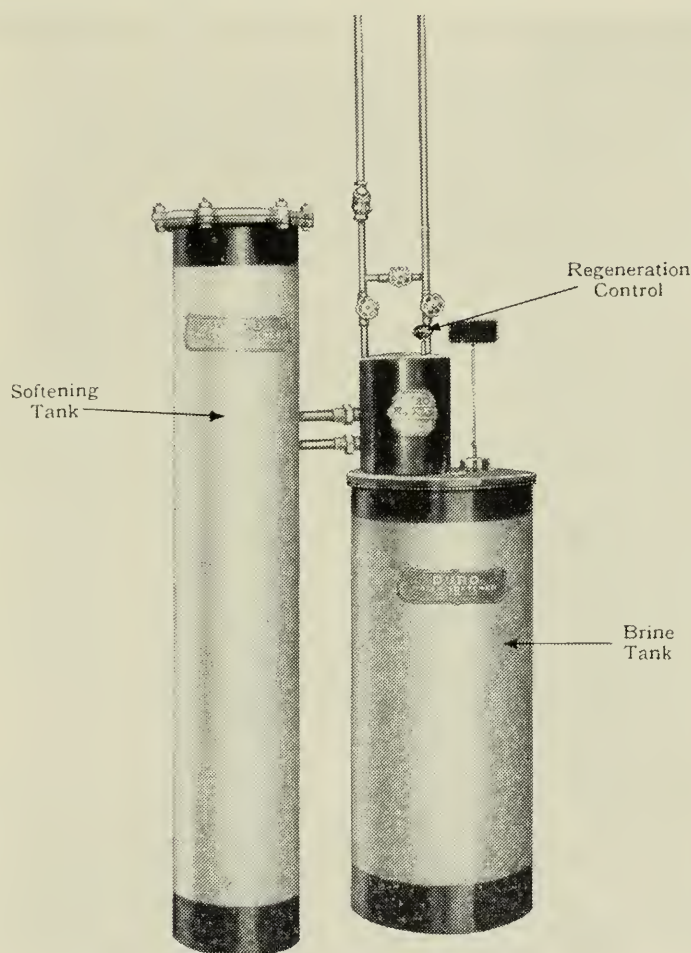


Fig. 28—An Automatic Water Softener
(Courtesy Pumps & Softeners, Ltd.)

Softeners are available in various capacities, rated in grains of hardness and maximum rate of flow. The grains capacity of a softener is the number of grains hardness the softener can remove between regenerations. In choosing a softener it is advisable that it be large enough to require regeneration not oftener than every two weeks. Capacity required depends on the hardness of the water, in grains per gallon, and the number of gallons of water used. Softeners are sometimes connected to the hot water supply only, to reduce the need for frequent regeneration.

Example—A household requires 50 gal. per day of softened water. The hardness of the water is 20 gr. per gallon. The softener should not require regenerating more often than every 3 weeks.

Hardness removed per day equals 50 gal. x 20 gr. per gal.=1000 grains

Hardness removed in 21 days equals 21 x 1000=21000 grains

Therefore a softener of 21000 gr. capacity would require regeneration every three weeks. Regeneration requires approximately one half lb. of salt per 1000 grains capacity. The above softener would require $\frac{1}{2} \times \frac{21000}{1000}$

=10½ lbs. per regeneration.

Softener manufacturers are equipped to test the hardness of the water, and will recommend the proper size and type of softener to install.

IRON REMOVAL

Some deep well waters contain iron in sufficient quantity to cause an unpleasant taste, stains on fixtures, and discoloration of clothes. Iron can be removed by aeration and filtration, but this is seldom practical on a farm scale. Most softener manufacturers can supply iron removal equipment. The action of these units is somewhat similar to that of the softener. The manufacturers should be consulted to determine the proper capacity of unit required, as well as installation and operation instructions.

Some softeners are able to remove iron from water. If iron is a problem the softener manufacturer should be consulted as to the proper type.

TREATMENT OF SULPHUR WATER

Some waters contain hydrogen sulphide in concentrations great enough to make them unfit for use, due to a pronounced odour of rotten eggs. Hydrogen sulphide can be removed by aeration, part of it being liberated as a gas, and part being oxidized to sulphur. An aerating device, for use with an overhead gravity tank, is shown in Fig. 29. If the use of an overhead tank is impossible, two pumps will be needed — one to pump water from the well to the aerator, and a shallow well type of pump to force water from the tank to the fixtures. It is doubtful if any device suitable for individual use can remove all the hydrogen sulphide from the water, but it can reduce the total amount, making it less objectionable.

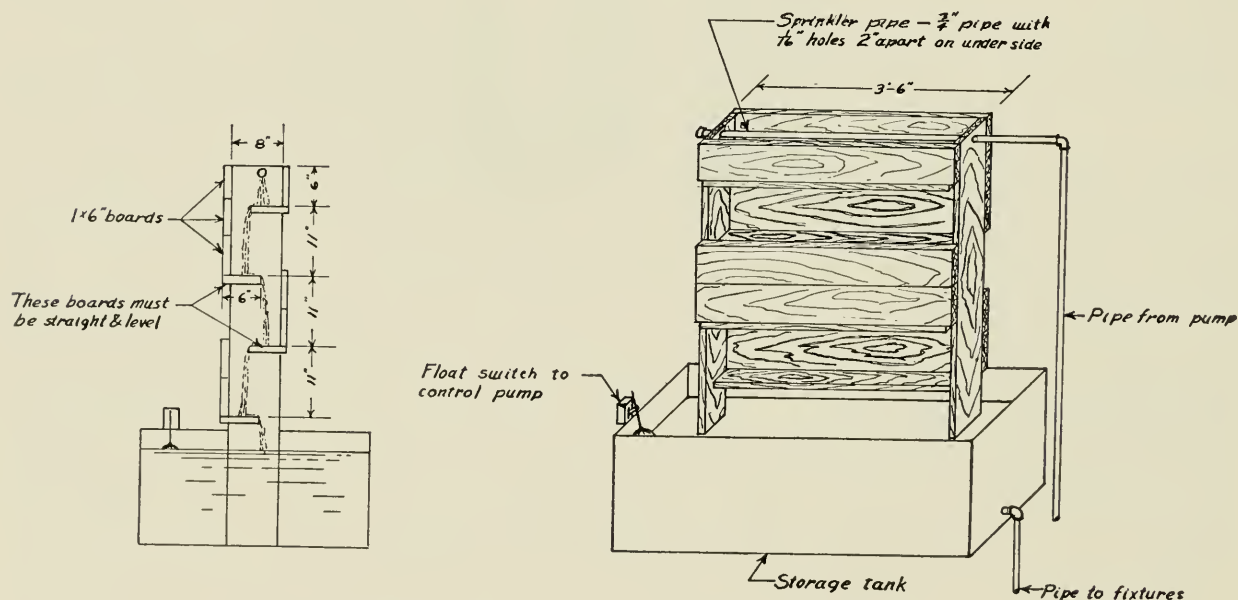


Fig. 29—Aerator for Sulphur Removal

FILTERS

Frequently the only water available is clouded by fine sand or clay particles, and sometimes by the entrance of surface water or other material. The water is unpleasant for use, and the question of filtering arises. Any turbid water should be suspected of being contaminated, and should be tested frequently for pollution. If it is safe, a filter may be used. As filters cannot be depended upon to remove all bacteria, they are not recommended for contaminated water, unless the water is to be sterilized before use by boiling or chlorination.

Filters may be made by the farmer, but are seldom satisfactory if large quantities of water are required. Homemade filters may clog, and eventually become breeding places for bacteria, unless they are properly cared for. The filtering material needs frequent cleansing and occasional replacement.

The filter shown in Fig. 30 may be used for rainwater or other turbid water. For best results the rate of flow through it should not be greater than five gallons per hour for each square foot of filter area. As the surface sand becomes clogged, half an inch should be scraped off. When the bed is only a foot deep the sand should be removed, the filter cleaned, and clean material replaced. If a layer of charcoal is used it should be changed yearly or oftener.

Filters, designed to connect between the pump and delivery pipe, are available commercially. They are more convenient than the home-made type as they are fitted with valves to make backwashing and cleansing relatively simple, and thus are more likely to be kept in a sanitary condition.

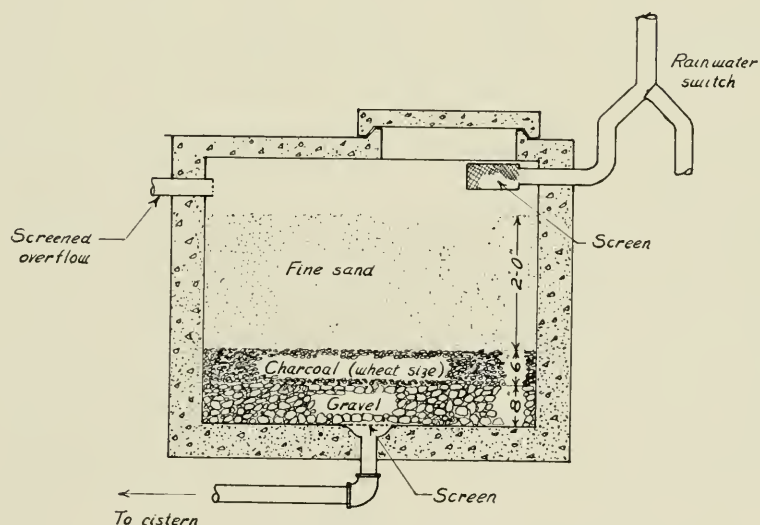


Fig. 30—A Home-made Filter for Rain Water

STERILIZATION

In some cases it is necessary to use water of doubtful quality for all household purposes. Some method of sterilization must be used to eliminate the danger of disease and make such water fit for drinking and cooking.

Boiling for 20 minutes will make such water safe to use and is a convenient method for sterilizing small quantities of water. After boiling the water should be cooled in a clean, covered receptacle. The flat taste of boiled water may be eliminated by aeration. This may be done by pouring the water from one vessel to another several times, or by vigorous stirring. For larger quantities of water chlorination is cheaper and more convenient.

Batch chlorination may be accomplished by adding a few drops of a commercial chlorine preparation to the water, stirring, and allowing it to stand for 15 minutes. When the concentrated chlorine solutions,

containing 12% chlorine, are used, from 1 to 2 drops will usually be required for two gallons of water. If the less concentrated Javelle water is used, from 10 to 12 drops will be required. Waters vary in their demand for chlorine, some requiring more, others less than above. If the purified water tastes distinctly of chlorine, too much has been used. A few trials will soon determine the maximum amount of chlorine solution which can be used without producing a chlorine taste. The use of too little may result in no purification. Keep the bottle of chlorine solution tightly stoppered, in a dark place, to prevent loss of strength.

For large quantities of water, automatic chlorine feed devices are available. These consist of a small pump which delivers an accurately measured quantity of hypochlorite solution to the water pump suction or delivery pipe. The operation is entirely automatic, requiring only occasional cleaning of the unit, and supplying of hypochlorite solution.

WATER SUPPLY PLUMBING

Water supply piping consists of the pipes which convey the water from the pressure system to the fixtures where it is to be used. It is essential that it is resistant to corrosion and adequate in size.

Copper tubing or galvanized steel pipe is commonly used. The first cost of copper tubing is higher, but it is easier to install. Flange-type fittings or soldered fittings are used with copper tubing hence little cutting and no threading is necessary. Copper is more resistant to corrosion in most waters and will withstand freezing to some extent.

Copper tubing is available in two main types—hard drawn, used with soldered fittings, which must be cut and fitted at corners, and soft drawn, which is usually used with the more expensive flange-type fittings and which is sufficiently flexible to be bent around corners and run inside existing walls. Consequently hard drawn tubing is used chiefly in new houses, being installed before the walls are completed, while soft-drawn is excellently adapted for modernization of existing dwellings.

Since galvanized steel pipe is rigid all changes of direction must be made by fittings. This pipe is cut and threaded with standard pipe tools. Black iron pipe should never be used for water supply work, as rust and corrosion result in short life, red-water troubles, and may cause damaging leaks.

A typical water supply piping system is shown in Fig. 31. The pipe sizes are based on the use of galvanized steel pipe. Where copper tubing is used it may be possible to reduce the pipe sizes by one size — i.e. $\frac{5}{8}$ " copper tubing instead of $\frac{3}{4}$ " galvanized, etc.

As installation of plumbing fittings requires more equipment than the average farmer has available, it is strongly recommended that a qualified plumber be hired to do the work.

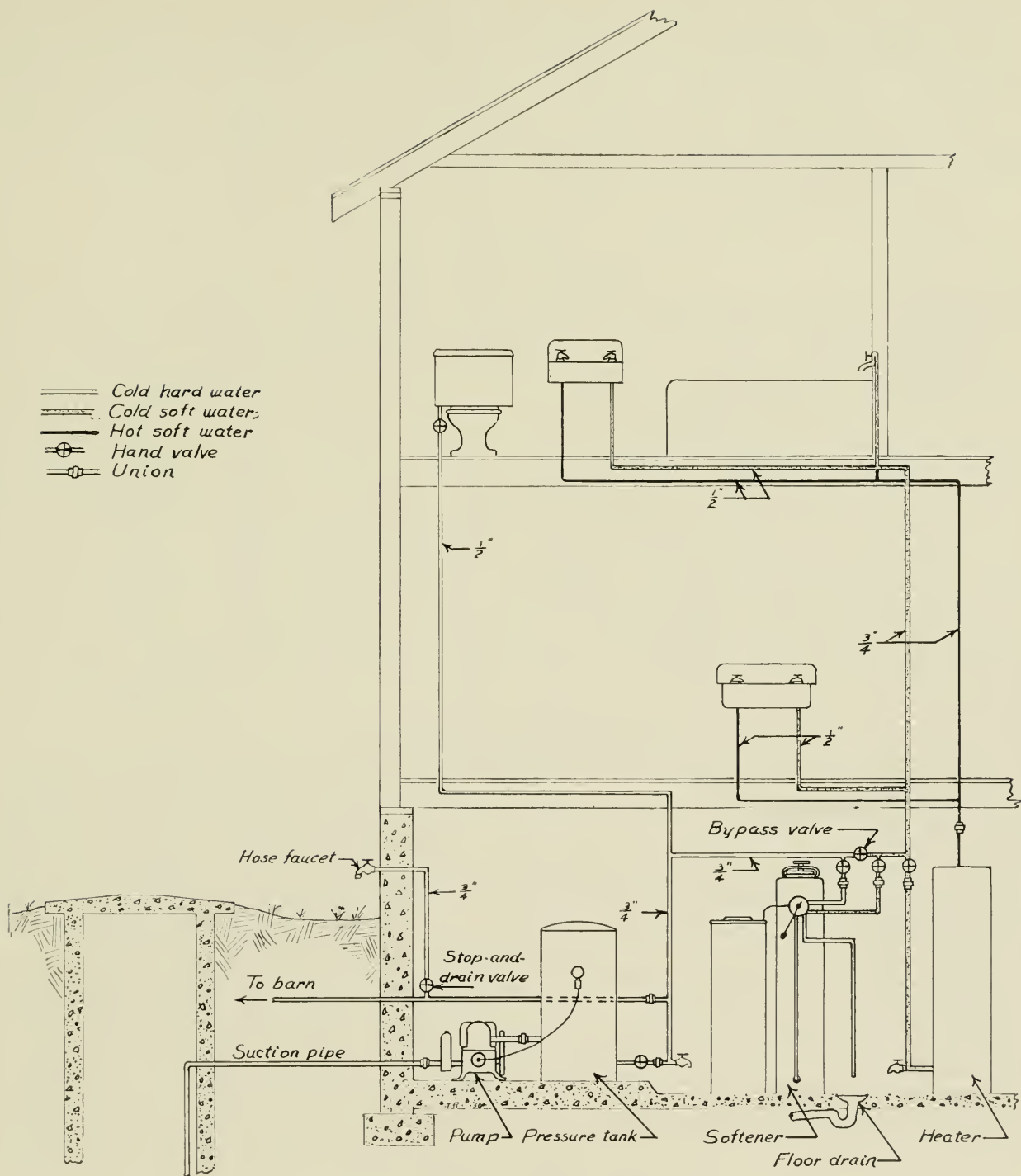


Fig. 31—Water Supply Plumbing

WATER SUPPLIES FOR STOCK AND OUTBUILDINGS

FARMSTEAD DISTRIBUTION PIPING

When the capacity of the well is adequate, water may be piped to the barn and outbuildings from the pumping system which supplies the house. Supply pipes to barns and outbuildings must be of adequate size, and laid below frost level, if satisfactory results are to be obtained.

The size of pipe necessary will depend on the rate of flow required, and the total length of pipe. Where a hydropneumatic system is used the

pipe size should be calculated to give a pressure drop due to pipe friction between pressure tank and faucet, of not much more than five lbs. per square inch. If a gravity system is used the pressure drop should be less.

Table III shows the sizes of pipe which are necessary to maintain satisfactory pressures at the faucets for various rates of flow and various lengths of pipe, when a hydropneumatic system is used.

TABLE II
Distribution Pipe Sizes

GALLONS PER MINUTE	LENGTH OF PIPE							
	50 ft.	100 ft.	200 ft.	300 ft.	400 ft.	500 ft.	700 ft.	1000 ft.
5	$\frac{3}{4}$ "	$\frac{3}{4}$ "	1"	1"	1"	$1\frac{1}{4}$ "	$1\frac{1}{4}$ "	$1\frac{1}{4}$ "
10	1"	1"	$1\frac{1}{4}$ "	$1\frac{1}{4}$ "	$1\frac{1}{4}$ "	$1\frac{1}{2}$ "	$1\frac{1}{2}$ "	$1\frac{1}{2}$ "
15	1"	$1\frac{1}{4}$ "	$1\frac{1}{4}$ "	$1\frac{1}{2}$ "	$1\frac{1}{2}$ "	2"	2"	2"
20	$1\frac{1}{4}$ "	$1\frac{1}{4}$ "	$1\frac{1}{2}$ "	2"	2"	2"	$2\frac{1}{2}$ "	$2\frac{1}{2}$ "
30	$1\frac{1}{4}$ "	$1\frac{1}{2}$ "	2"	2"	$2\frac{1}{2}$ "	$2\frac{1}{2}$ "	$2\frac{1}{2}$ "	3"

Distribution Pipe Sizes

For the majority of farms it is suggested that the size of the distribution main be calculated for a maximum flow of 10 gallons per minute, and individual branches to float tanks, hose faucets, etc., for a maximum flow of 5 g.p.m. On farms where the water requirements are so great that a pump capacity of over 600 gallons per hour is recommended, the size for the distribution main should be calculated for a flow equal to, or somewhat greater than, the pump capacity in gallons per minute.

For example, in the system shown in Fig. 32, the pipe from the pump-house, past the poultry house, to the dairy barn is 200 feet long, and should be capable of maintaining a flow of 10 gallons per minute. From Table II a 10 g.p.m. flow through 200 feet of pipe requires $1\frac{1}{4}$ " pipe. The individual branches to the stock tank, poultry house, and hydrant at the machine shed are all less than 100 feet long, and should be capable of a flow of 5 g.p.m. Table II shows that $\frac{3}{4}$ " pipe would be suitable.

All underground pipe should be galvanized or copper and should be carefully joined and tested before covering, to ensure long, trouble free service. It should be laid on a slight slope upward from the pump so it may be drained if necessary.

In many cases it is not possible to install the complete distribution system at once. It is recommended, however, that a plan of the complete system be made and pipe sizes calculated, then when installing that part which is to be done immediately, this plan be followed. Plugged tees should be located wherever branches are to be taken off in future and adequate sized mains should be used to take care of future expansion, so that when expansion is possible it will not be necessary to scrap the original installation, or be troubled in future years with insufficient

pressure. Whenever pipes are installed underground a plan showing their location should be made and carefully filed away. If repairs should become necessary the plan will show the location of the pipes, and save a great deal of digging in trying to locate them.

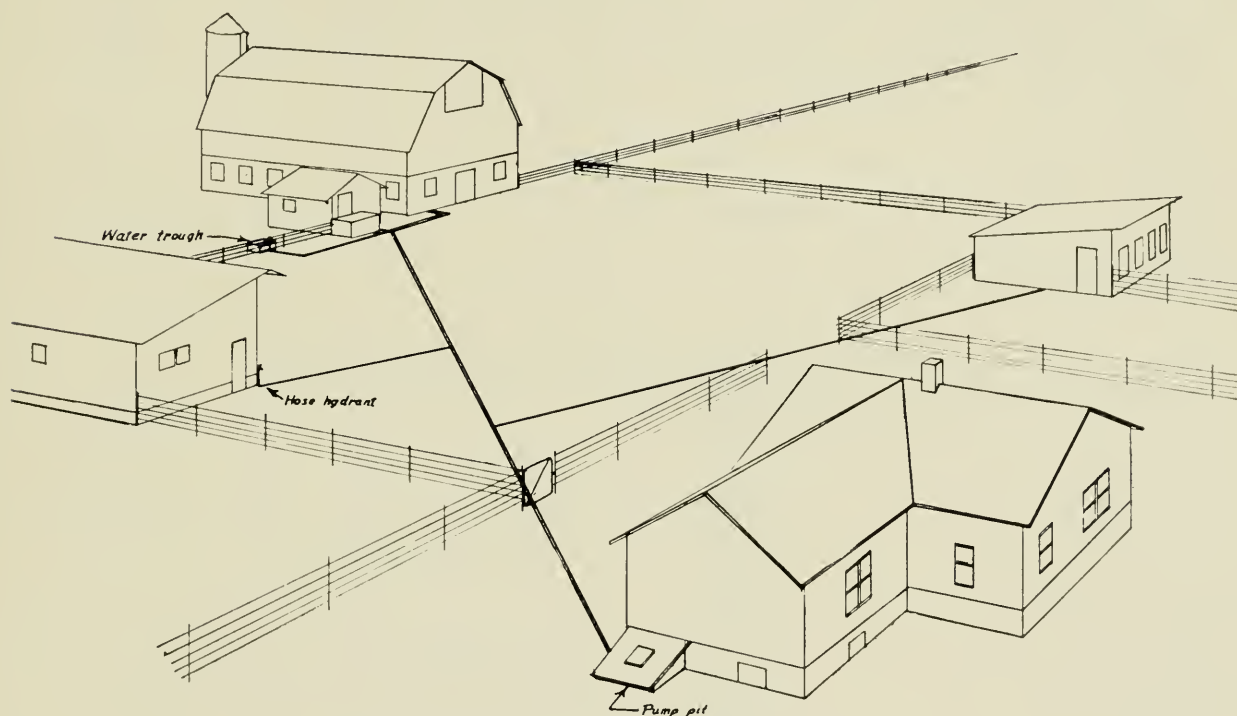
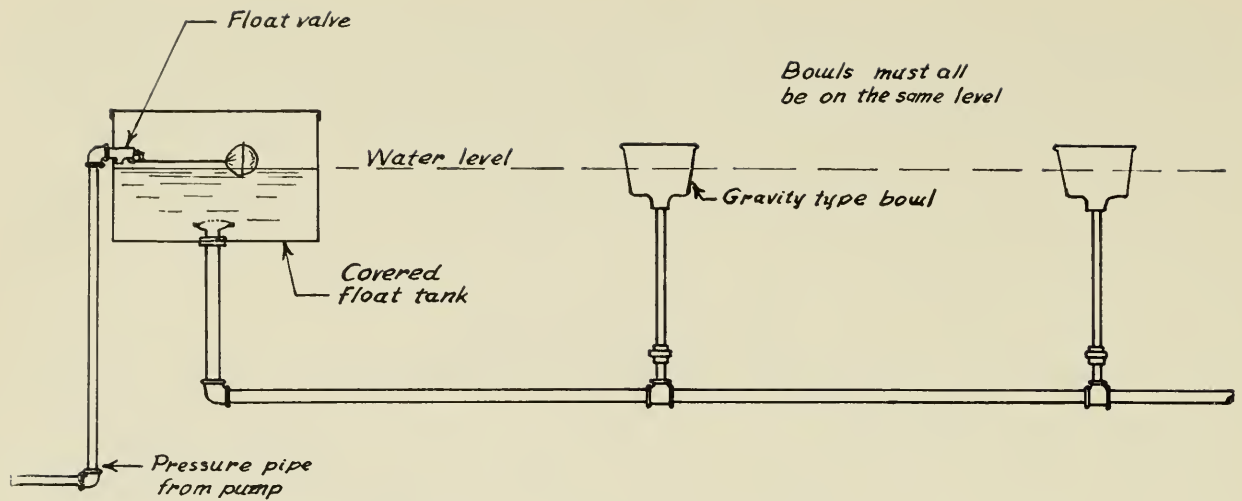


Fig. 32—Farmstead Distribution System

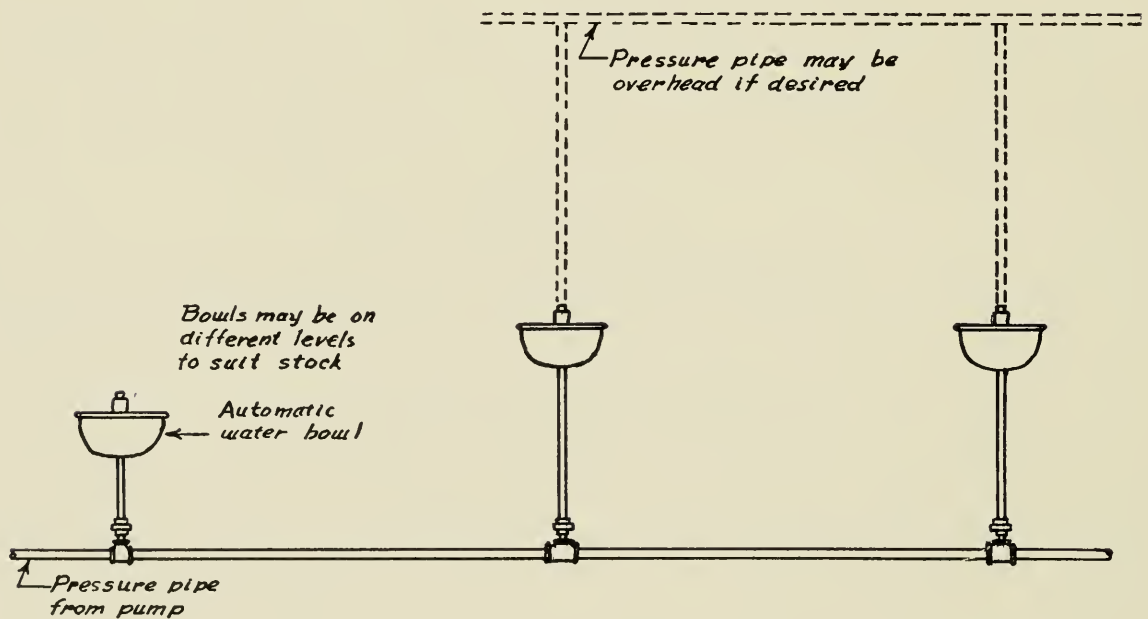
SUPPLYING WATER TO STOCK

Individual water bowls are highly recommended for dairy stables. Tests have shown that dairy cattle will produce more when they have a constant supply of fresh water available. Two types of water bowl are used. A gravity system, in which the water is maintained at a constant level by a float-controlled valve in a reservoir, requires that all bowls be at the same level. The more common type has a false bottom in the bowl. When the cow, seeking water, presses this plate a valve is opened and water is admitted from the pressure pipe. These systems are shown in Fig. 33.

Float valves may be used to maintain the water at a constant level in stock watering troughs. The float mechanism must be protected from interference by animals or poultry, which could result in the trough overflowing. They are particularly useful for poultry houses, or for watering stock in feed lots or pasture. They cannot be used outdoors in the winter, due to danger of freezing. Branch lines serving them should be shut off and drained in the winter months.



GRAVITY WATER BOWL INSTALLATION



PRESSURE WATER BOWL INSTALLATION

Fig. 33—Watering Systems for Dairy Cattle

HYDRANTS

Outdoor hose faucets are a necessity on every farm. A hose may be used, not only for watering gardens and lawns, but also for washing automobiles, and machinery, and may be invaluable in case of fire. Outdoor faucets are exposed to frost, so must be arranged so that they can be easily drained when not in use.

A simple method of draining sill cocks is shown in Fig. 31. A stop and waste valve is installed on the branch inside the house. When winter approaches, the branch is shut off and drained, by closing the stop and

waste valve, being sure that the waste opening is clear, and opening the sill cock.

The above method is inconvenient where water is required all year around, as for stock tanks and poultry houses. A frost-proof hydrant, as shown in Fig. 34, is more satisfactory. The valve, operated by a long handle, is located below frost level, and arranged to drain the vertical pipe when the water is shut off. Frost-proof hydrants are available

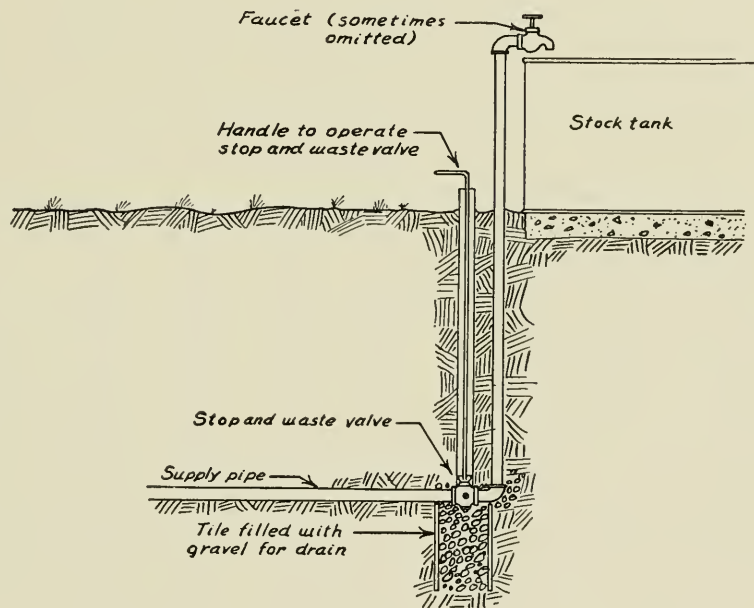


Fig. 34—Frost-proof Hydrant Installation

commercially, or may be made up with standard pipe fittings. Usually a faucet is used, as shown in Fig. 34, to control the flow of water in the summer, or a float valve may be used. When there is any danger of freezing, however, the faucet should be left open and the water turned on and off by the stop and waste valve. Float valves should be removed or held open in the winter. Sometimes the faucet is omitted, water being turned on and off at all times by the stop and waste valve.

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DOES YOUR SOIL NEED LIME?

CARONAF6
B477

SOILS DEPARTMENT
ONTARIO AGRICULTURAL COLLEGE
GUELPH, ONTARIO



THE MODERN WAY TO APPLY LIME

ONTARIO DEPARTMENT OF AGRICULTURE
STATISTICS AND PUBLICATIONS BRANCH, TORONTO, ONTARIO

HOW TO TELL WHETHER SOIL NEEDS LIME

1. Send a representative sample of soil to your soil testing laboratory along with notes on kind of soil, drainage, previous liming and crops to be grown. (Sample boxes all ready to mail, and printed suggestions on taking samples and sending them, may be obtained from your County Agricultural Representative.)
2. You may see whether your farm is in an area where lime is likely to be needed by looking at the map on pages four and five.
3. Where yellow and reddish sheep sorrel appears in sod fields in June an acid soil is indicated.
4. Poor catches and stands of alfalfa and clover may result from need for lime. (On "cold", wet soil liming will not take the place of improved drainage.)



Alfalfa on a low-lime sandy soil.

**Left
Lime**

**Right
No Lime**

DO NOT LIME LAND UNLESS IT IS NEEDED

1. Much of the land in Southern Ontario is well supplied with lime. Liming such land may do harm by making nutrients less available to crops; it also is a waste of time and material.

WHY LIME?

1. Legume crops particularly alfalfa and clovers grow best on a fertile soil containing plenty of lime.
2. Grain and hoed crops benefit from the increased nitrogen fixed by legumes as well as from the heavier sods plowed in.
3. Sugar beets, cabbage and cauliflower prefer a soil well supplied with lime.

The following three pictures show the effects of lime and fertilizer on the growth of sweet clover on a clay soil, low in lime.

NO TREATMENT



**2 TONS LIME
(PER ACRE)**



**2 TONS LIME
+
FERTILIZER**

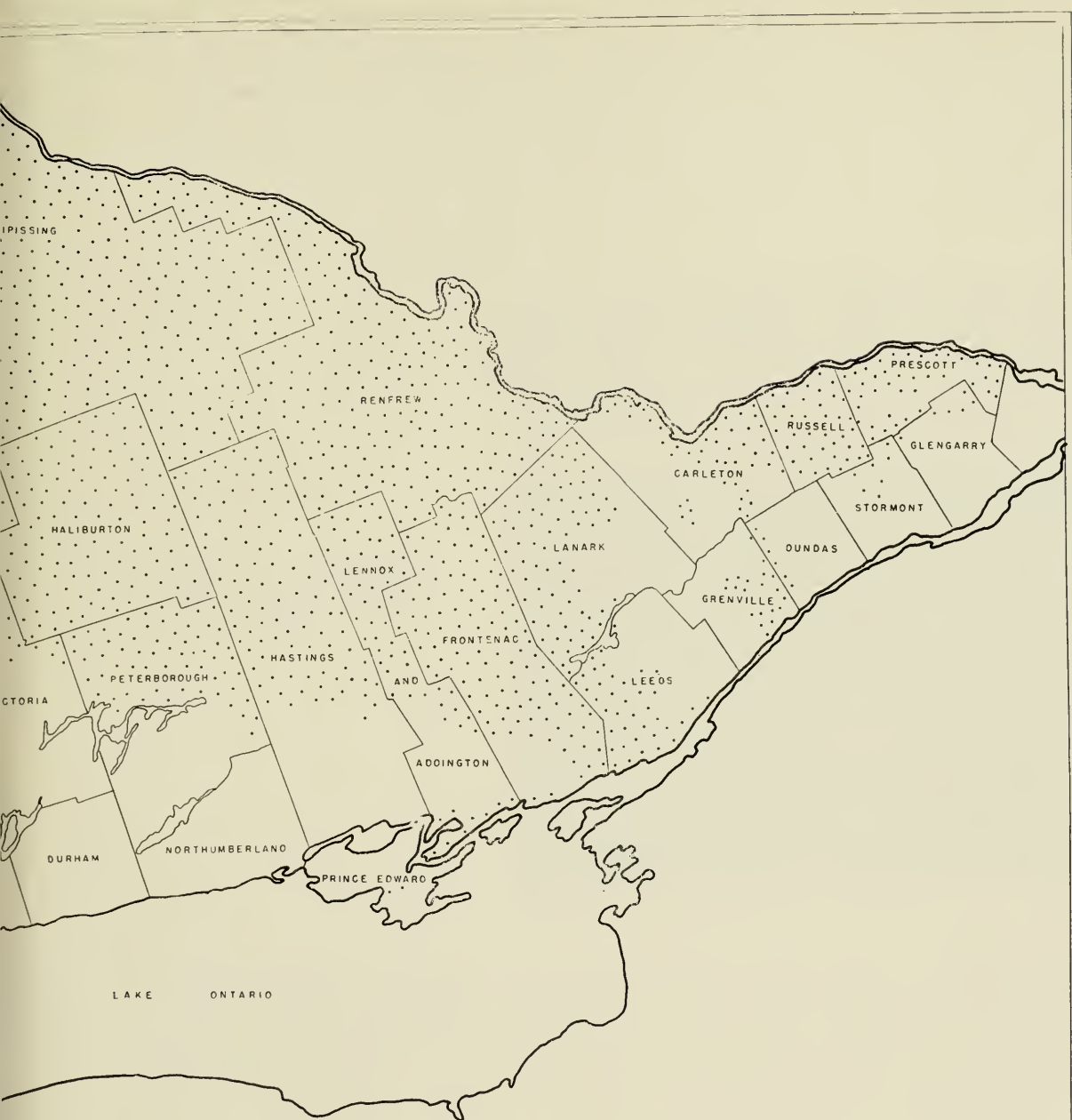


MAP SHOWING LIME SUPPLY

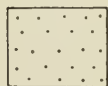


NOTE—While most of the soils of **NORTHERN ONTARIO** are low in lime, many in the better farming areas have a plentiful supply.

N SOUTHERN ONTARIO SOILS



LOW-LIME SOILS IN SOUTHERN ONTARIO



AREAS WHERE LOW-LIME SOILS MOST FREQUENTLY OCCUR.



AREAS WHERE LOW-LIME SOILS SELDOM OCCUR.

Map prepared from Soil Survey data.

HOW MUCH SHOULD BE APPLIED?

1. The soil test report will state whether lime is needed and give an estimate of the rate.
2. Clay soils need more than sandy soils to correct an acid condition.
3. The more finely ground limestone acts more quickly but does not last as long.



**These gray eroded knolls
have an abundance of lime.**

WHAT ARE THE SOURCES OF LIME?

1. Your County Agricultural Representative can furnish advice on local sources and prices.
2. Ground limestone is used most widely for liming. It is most plentiful and is usually the cheapest material. Dolomitic limestone contains both magnesium and calcium and calcitic limestone contains mostly calcium. Either type is satisfactory.
3. Lime refuse from some manufacturing plants is satisfactory.
4. Hydrated lime may be used but is more expensive.
5. Quick lime should not be used as it may burn the crops. It is expensive also. Slaked lime is all right if available.
6. Other materials such as marl and fresh wood ashes have a fairly high content of lime and are suitable where available.

WHEN AND HOW TO APPLY LIME

1. The lime should be broadcast evenly over the land. Any kind of lime spreader that will do the job evenly is satisfactory. In some areas there are truckers who haul and spread lime directly on the land using a spreader on the back of the truck. (See cover page.) This does away with much of the handling and is often the cheapest in the long run.
2. It may be applied whenever the ground is firm and dry. Liming after harvest the year before seeding down is one of the best times.

Loading lime from a pile which has been dumped in the field.



This has been the usual way to spread lime.
(Photo by courtesy of John Deere Plow Company, Limited)



GOVERNMENT SUBSIDY FOR FREIGHT AND HAULAGE OF LIME

Where lime is needed the Dominion and Provincial Governments help farmers to get it by paying a portion of the carrying charges for suitable liming material. The Railways also assist by providing a reduced tariff on agricultural lime transported by rail. Full information on this subsidy may be had from your Agricultural Representative. He can issue the necessary permit by which to get this assistance.

MOVEMENT OF AGRICULTURAL LIMESTONE 1939-1948

Year	Car	Tons By Rail	Tons By Truck	Total Tonnage
1939	130	4,471		4,471
1940	180	3,304		3,304
1941	50	2,163		2,163
1942	69	2,525		2,525
1943	102	3,316		3,316
1944	162	5,860		5,860
1945	234	8,169	765	8,934
1946	251	9,312	1,554	10,866
1947	281	10,751	3,319	14,071
1948	462	17,828	8,047	25,875



LOADING AT THE QUARRY

BACTERIAL DISEASES OF PLANTS

By E. H. GARRARD

DEPARTMENT OF BACTERIOLOGY

ONTARIO AGRICULTURAL COLLEGE

:::

GUELPH, ONTAR

CARONAF6
B478



FIRE BLIGHT OF APPLE

ONTARIO DEPARTMENT OF AGRICULTURE

STATISTICS AND PUBLICATIONS BRANCH

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TORONTO, ONTARIO

BULLETIN 478

JANUARY, 1951

Foreword

Among the many bacterial diseases of plants listed as having occurred in various parts of the world, more than fifty of these have been reported in Canada. Detailed descriptions of these diseases have appeared in various texts, reports and scientific journals which are not always accessible to fieldmen or farmers. In view of the interest of students, inspectors, agricultural representatives, etc., in some of these diseases, it was thought advisable to gather together in bulletin form, descriptions of the majority of bacterial diseases occurring in Canada.

Each disease has been described in simple form and it is hoped that the descriptions of the symptoms will be of assistance in recognizing the various diseases. There are few or no practical control measures for some diseases; also, repetition of certain control measures is unavoidable. Comparatively few bacterial diseases of plants can be controlled by spraying or dusting and in many cases, prevention rather than cure must be the rule.

The assistance of Dr. I. L. Connors, Plant Pathologist, Department of Botany and Plant Pathology, Science Service, Ottawa; Dr. G. H. Berkeley, Senior Pathologist, and Mr. J. K. Richardson, Dominion Laboratory of Plant Pathology, St. Catharines, Ontario; Professor J. A. Carpenter, Department of Bacteriology, O.A.C., Guelph, and Professor D. H. Jones, former Head of Department of Bacteriology, O.A.C., Guelph, whose permission was obtained to include many of his original photographs, is gratefully acknowledged.

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GLOSSARY

- Blight** — Rapid killing of affected parts, often accompanied by shrivelling of foliage.
- Canker** — An area of diseased tissue, generally on woody stems.
- Chlorosis** — Yellowing of normally green tissue.
- Corm** — A solid rounded underground stem.
- Culm** — The stem of a grass or sedge.
- Defoliation** — Stripping or dropping of leaves.
- Dissemination** — The act of spreading infective material from diseased to healthy plants.
- Epidermis** — The outside and protective layer of a leaf.
- Exudate** — Ooze, slime or liquid discharge from diseased tissues.
- Fasciation** — A condition whereby abnormal, flattened and twisted shoots are formed.
- Gall** — Nodular swellings of plant tissue as a result of attack by bacteria, fungi or other agencies.
- Glume** — A chaffy bract subtending a grass spikelet.
- Halo** — A light colored or yellowish border surrounding a leaf lesion or spot.
- Host** — The plant affected with, or subject to a given disease.
- Inoculate** — The placing of disease bacteria or infective material in new tissue.
- Lesion** — Localized spot of diseased tissue.
- Necrotic area** — Death of the tissue in an affected area, usually resulting in tissue turning dark.
- Node** — The place on a stem from which a leaf or branch springs.
- Panicle** — An irregularly compound arrangement of pedicelled flowers.
- Pedicle** — A secondary flower stalk; the support of a single flower in a cluster.
- Peduncle** — The support of a solitary flower or a flower cluster.
- Petiole** — A leaf stock.
- Rhizome** — A creeping underground stem; a root stock.
- Rachis** — The axis of a frond, compound leaf or inflorescence.
- Rot** — The term applied when killed tissue becomes discolored and decayed.
- Saprophyte** — An organism feeding on dead, organic matter.
- Sheath** — A tubular envelope.
- Stomata** — Pore openings on a leaf surface.
- Vascular bundles** — A collection of vessels or ducts found in the stems of plants.
- Wilt** — The term applied where all, or part of a plant becomes limp owing to loss of turgor, usually followed by shrivelling or withering.



Fig. 1. Fire Blight of Pear and Apple. 1 — Diseased Bartlett pear tree. 2 — Blight canker at base of a water sprout on apple tree. 3 — Blight cankered pear limb. (After D. H. Jones.)

1. DISEASES OF TREES AND SHRUBS

FIRE BLIGHT OF PEAR AND APPLE

Cause

Erwinia amylovora (Burrill) Winslow et al.

Plants Attacked

Pear, apple, quince, crab, hawthorn, mountain ash and other related wild and ornamental trees.

Symptoms

1. *Blossom and twig blight* — Primary infection of the blossoms is brought about by flower visiting insects whose feet and mouth parts have become contaminated with the disease bacteria from infected tissue, and by rain contaminated with bacterial ooze. The bacteria attack the blossoms and pass in to the peduncle, causing the blossoms to become blackened and shrivelled. The bacteria may proceed in to the twig from infected blossoms, or the twigs may become infected from leaves that have been punctured by contaminated insects. The twigs and leaves become blackened and shrivelled and may remain attached to the tree throughout the winter.

2. *Limb blight (Blight canker)* — The disease in the branches and larger limbs may result from the bacteria progressing down from infected twigs, or from water sprouts and suckers that have been attacked by contaminated aphids. In warm, damp weather, and where the trees are cultivated too frequently, the disease may progress at the rate of 2" per day. The bacteria are confined to the inner bark and their progress is followed by blackening, shrivelling and death of the limb.

Cankers on trunk or larger limbs result from infection through wounds by mechanical means and bark boring beetles, or aphids. A canker is formed which becomes blackened, dried or shrivelled, and separated from the healthy tissue by cracks, from which may ooze contaminated exudate. The bacteria are able to remain alive but inactive in such cankers until the following year. Both limb blight and body canker may cause the death of the tree if not checked.

Control

1. Cut out diseased limbs at least 10" beyond affected areas and burn. Apply corrosive sublimate, 1:1000 (1 tablet in 1 pint of water, or 1 oz. in 6 gals. water) to cut surfaces.

2. Cut out cankers at least 3" beyond affected areas and apply corrosive sublimate, 1:1000.

3. Effective control has been claimed by treating the cankers with zinc chloride solution. This is prepared by adding 3 oz. of concentrated hydrochloric acid to 2 pints of hot water in which is dissolved 6 lbs. of dry zinc chloride. After cooling, 7 pints of denatured alcohol are added. This solution, which may be stored for years, is brushed on and around the cankered areas.

4. Eliminate affected intermediate hosts, such as hawthorn, mountain ash, or derelict, neglected apple or pear trees.

5. Spray to control insects, especially aphids. Spraying with Bordeaux mixture, 1-3-40 (1 lb. blue-stone, 3 lbs. fresh hydrated lime and 40 gals. of water) twice, in middle and late stages of bloom, is considered to reduce infection.

6. Prune to prevent excessive number of tender shoots, and disinfect all pruning tools in corrosive sublimate.

7. Avoid over-fertilization, and especially with pears, reduce rapid growth by growing in sod strips.

BACTERIAL BLIGHT OF LILAC



Fig. 2. Bacterial Blight of Lilac. 1 — Diseased flower clusters. 2 — Distorted appearance of affected leaves. 3 — Petiole infection resulting in blackened shrivelled leaves. (After Bryan.)

Cause

Pseudomonas syringae van Hall.

Plants Attacked

Lilac, citrus, cow pea, lemon, cherry and other unrelated plants.

Symptoms

The disease usually affects the young shoots in the spring, producing black stripes on the internodes and irregularly shaped brown to black spots on the leaves which are surrounded by a yellowish halo. Where leaf spots are plentiful and join together, the leaves may become distorted or present a ragged appearance. Stem and petiole infection result in blackening and shrivelling of leaves and twigs, resembling the scorched appearance of Fire Blight.

The flowers of white flowered varieties, which seem to be more susceptible to the disease, may be attacked and become limp and blackened. The bacteria gain entrance through natural pore openings on leaves and stems or through wounds. The disease is more evident in rainy, mild weather.

Control

1. Cut out diseased parts and burn.
2. Thin plants to provide air circulation and to prevent limb rubbing.
3. Avoid excessive manuring.
4. Spraying with Bordeaux, 2-2-40 (2 lbs. blue-stone, 2 lbs. fresh hydrated lime and 40 gals. of water) as soon as the disease appears may prove helpful.

BACTERIAL BLIGHT OF MULBERRY



Fig. 3. Bacterial Blight of Mulberry. 1 — Blight of terminal twigs. 2 — Distortion of leaf. 3 — Ragged condition of leaf. (After Doidge.)

Cause

Pseudomonas mori (Boyer and Lambert) Stevens.

Plants Attacked

Mulberry.

Symptoms

Numerous water-soaked lesions appear on the leaves and shoots, which later become enlarged, sunken and black. The leaves become distorted and ragged in appearance. Dark black spots occur on the veins. Longitudinal stripes appear on shoots and small branches which become sunken and black; bacterial ooze exudes from the pore openings. Bark and wood are affected resulting in shrivelling and blackening, somewhat resembling Fire Blight.

Control

1. Remove and burn all affected twigs and branches.
2. Do not plant young mulberry trees near old affected trees.

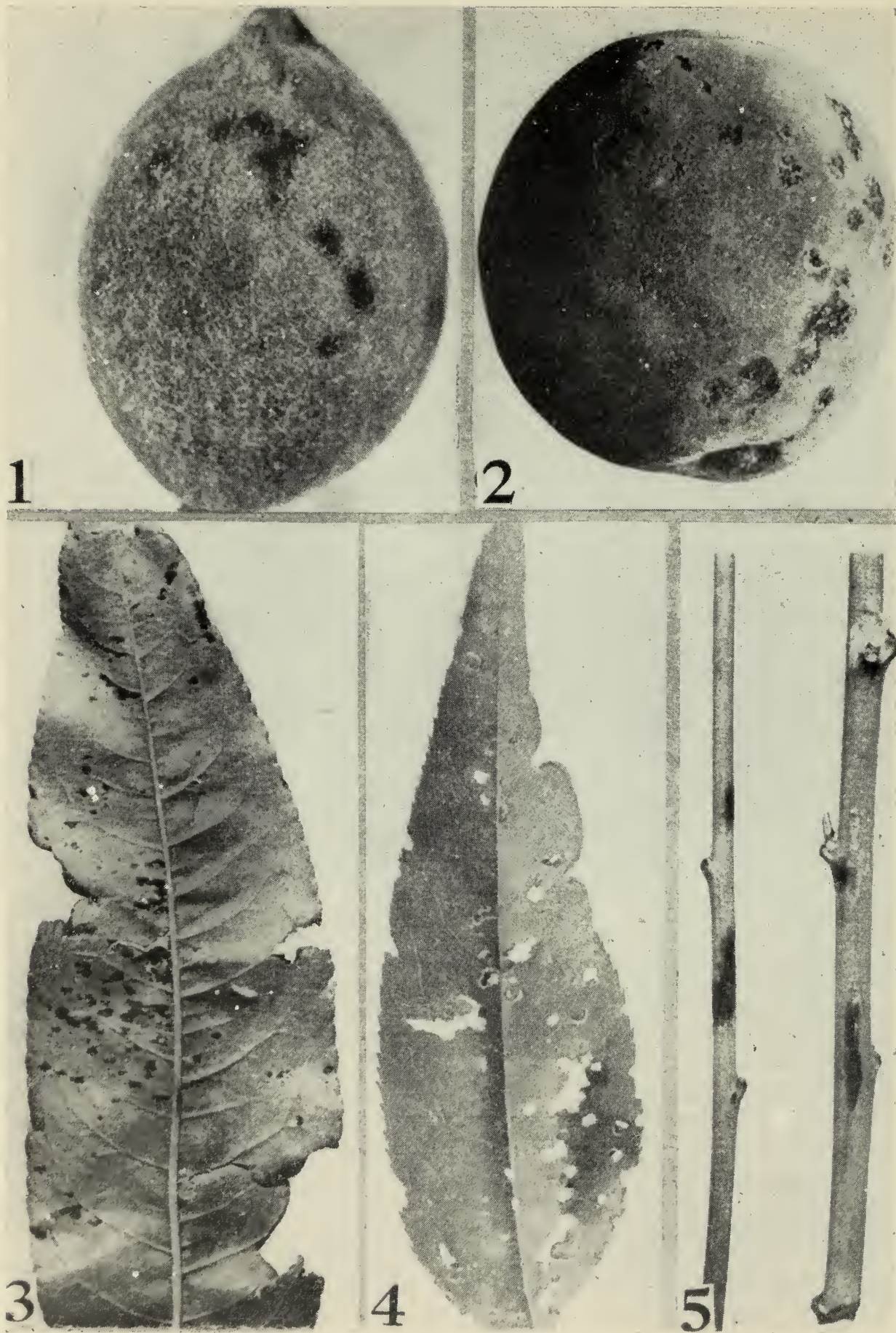


Fig. No. 4. Bacterial Spot of Plum and Peach. 1 and 2 — Spots on Elberta peaches. 3 — Leaf spots on peach leaf. 4 — Shot-hole appearance of spots on leaf. 5 — Cankers on stems of peach. (After Dunegan.)

BACTERIAL SPOT OF PLUM AND PEACH

Cause

Xanthomonas pruni (Erw. Smith) Dowson.

Plants Attacked

Plums, peach, apricot and nectarine. Japanese varieties of plums and Elberta peaches are most susceptible.

Symptoms

The disease affects leaves, twigs and fruit. The bacteria usually gain entrance through pore openings or insect punctures. The disease in the leaves appears first as small spots which enlarge to become irregularly shaped, reddish to brown areas, the centres of which may drop out, leaving a "shot hole" appearance. Where spots are numerous, the leaves may present a tattered or ragged appearance. A yellowing of the leaves usually is found on peaches. Heavy infection in the leaves may result in severe defoliation.

On twigs and small branches, the disease appears in the form of shallow cankers, dark colored and cracked, through which ooze or gum may exude. The cankers are from one-half to two inches long and the infection in such areas is important as the bacteria overwinter in these cankers. The bacteria also overwinter in terminal buds.

The disease appears on the fruit as small, water soaked spots which slowly enlarge, becoming brown to black in color. The centres of the lesions become sunken, and frequently crack open, thus causing fissures from which a yellow gum-like exudate collects. These globules of bacterial ooze supply the means by which the disease is spread by rain, dew and insects. The injury to the fruit is not necessarily severe as the spots do not penetrate very deeply, but the fruit is unsightly and unmarketable.

Control

1. Prune to remove cankered twigs and burn. Also prune terminal buds on peaches.
2. Eliminate old neglected plum, peach, apricot and nectarine trees that may harbor the bacteria.
3. As trees which are in a good state of health and vigor are almost resistant to the disease, it is essential that proper pruning, cultivation and fertilization be followed.
4. Where soil is poor, apply liberal applications of manure or fertilizer.
5. Spraying plums with Bordeaux 4-4-40 (4 lbs. blue-stone, 4 lbs. fresh hydrated lime and 40 gals. of water) and peaches with zinc-lime spray (4 lbs. zinc sulphate, 4 lbs. fresh hydrated lime and 40 gals. of water) has been claimed to assist in controlling the disease.



Fig. 5. Bacterial Blight of Walnut. 1 — Disease on half grown walnuts. 2 — Blight on leaves and twigs. (After R. E. Smith.)

BACTERIAL BLIGHT OF WALNUT

Cause

Xanthomonas juglandis (Pierce) Dowson.

Plants Attacked

English walnut and its hybrids.

Symptoms

The disease affects the tender parts of the tree including leaves, shoots, twigs and nuts. The bacteria gain entrance into the stomates or natural pore openings where they produce circular to angular spots, brown or black in color. Affected petioles and veins also become brown or black. Where spots are plentiful, or joined together, large diseased areas are formed which may cause distorted or ragged appearance of the leaves.

In young shoots and twigs, the disease appears as water soaked areas which develop into irregularly shaped lesions, extending two to three inches in length. In severe cases the shoot may be destroyed to the pith. The disease becomes less severe as it progresses into the large branches. Eventually the diseased portions become blackened, shrivelled and deformed. The bacteria overwinter in affected twigs and branches and are spread by rain, fogs and insects.

The disease generally is most severe in the nuts, and starts as small circular, discolored spots which gradually enlarge into black, sunken lesions. While the nuts may be infected on any part of their surface, the most common form of infection on young nuts is at the blossom end. When once the disease has started at this point, it continues until the kernel is affected, which becomes blackened and destroyed. Many such diseased nuts fall. Late infections result in shallow lesions which ordinarily do not penetrate to the kernel, but cause the hull to cling to the shell of the nut.

Control

1. Where possible, prune infected trees and burn diseased material and nuts.
2. Obtain reliable, disease-free nursery stock.
3. The most promising means of control appears to lie in the development of disease resistant varieties.

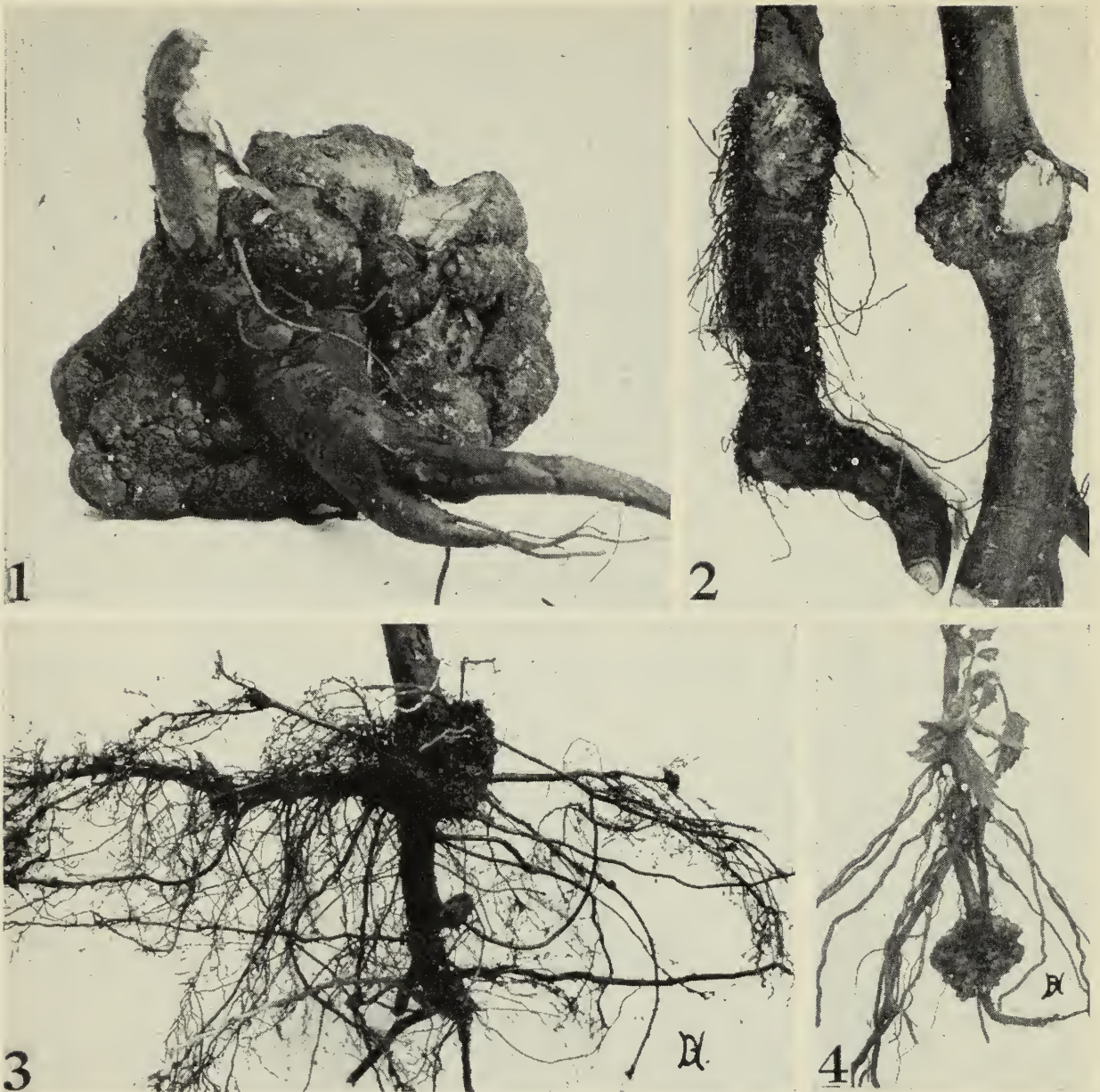


Fig. No. 6. Crown Gall of Plants. 1 — Gall of rhubarb. 2 and 3 — Crown gall and hairy root on roots of young apple trees. 4 — Young gall on raspberry root. (After D. H. Jones.)

CROWN GALL OF PLANTS

Cause

Agrobacterium tumefaciens (Smith and Townsend) Conn.

Plants Attacked

Many species of wild and cultivated plants are affected. It is most common on stone, pome and bush fruits, such as peach, plum, apricot, apple, pear, rose, raspberry, blackberry, etc. It also has been found on chestnut, walnut, poplar, willow, grape, red clover, alfalfa, sugar beet, hop, lettuce, daisy, turnip, parsnip, rhubarb and other plants.

Symptoms

The bacteria gain entrance through wounds, where they stimulate the plant to produce galls or tumours more frequently found on the roots. These galls are abnormal, nodular swellings and may range in size from a fraction of an inch to many inches in diameter. They may be few or many in number, soft or hard, spherical or irregular in shape and differing in other respects, depending upon the plant attacked. The disease may take the form of "hairy root", supposedly caused by a closely related strain of bacteria, *Agrobacterium rhizogenes* (Riker et al.) Conn, in which many fine root hairs are produced, either alone or associated with the gall. Aerial galls also are occasionally found. Where galls are small and few in number the plant may not be seriously affected; on the other hand, large galls may cause yellowing, stunting and probably death of the plant.

Galls on black and purple cane raspberries are known to be caused by *Agrobacterium rubi* (Hildebrand) Starr and Weiss, another closely related strain of bacteria.

Control

1. Do not plant stock that shows signs of the disease.
2. Avoid injury to roots and crown of plants.
3. Where crown gall has been present, do not plant susceptible host plants on the same soil for three to four years. Grain crops, which usually are not susceptible to the disease, may be safely grown.
4. It is recommended that careful grafting operations be followed, and the grafts should be dipped in corrosive sublimate 1:1000 (1 tablet in 1 pint of water, or 1 oz. in 6 gals. of water), or other suitable disinfectant, after wrapping and before planting.

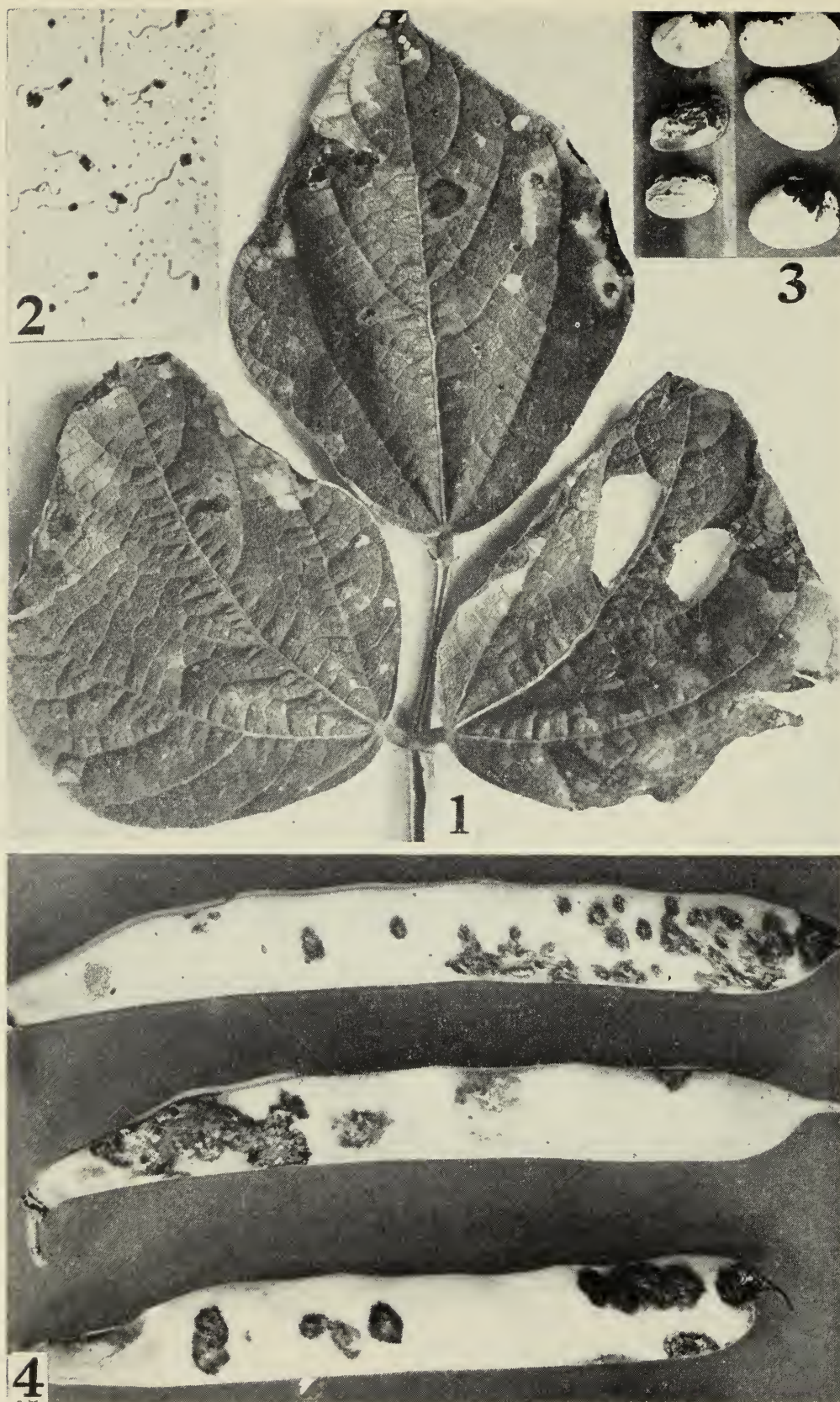


Fig. No. 7. Bacterial Blight of Bean. 1 — Disease on bean leaves. 2 — Causal organism. 3 — Diseased and healthy seed. 4 — Bean pods showing typical lesions. (After D. H. Jones.)

II. DISEASES OF VEGETABLES AND FIELD CROPS

BACTERIAL BLIGHT OF BEAN

Cause

Xanthomonas phaseoli (Erw. Smith) Dowson.

Plants Attacked

Field and garden bean, runner bean, lima bean, soybean and cow pea.

Symptoms

The disease affects leaves, stems, pods and beans within the pods. The bacteria gain entrance into the pore openings and cause the appearance of water soaked spots which develop into irregularly shaped, reddish brown lesions surrounded by a yellow border. If the leaves are attacked in early stages, they become distorted and shrivelled and may drop off. Diseased portions may break away or fall out leaving a ragged appearance with the leaves full of holes.

On stems and petioles, the lesions develop into brown cankered areas, extending up and down and often girdling the part. They may become dry and brittle and easily broken, resulting in defoliation.

The lesions on the pods appear as blistered, cankered reddish spots, slightly raised above the healthy tissue. A yellowish white ooze exudes from the diseased areas. In severe cases the bacteria may penetrate into the bean seeds within. Thus infected, the seeds do not mature but are shrunken and brown. If the seeds are infected when mature, they become smeared with the gummy exudate which dries in a hard varnish-like coating. In this dried exudate, the bacteria may remain alive but dormant for many years.

This disease should not be confused with the fungus disease anthracnose which it somewhat resembles. Pods affected with anthracnose show similar lesions which are not raised, but pitted or sunken below the surrounding healthy tissue.

Young seedlings grown from contaminated seed, may not show the above symptoms, but become dwarfed and wilted.

The disease bacteria are spread largely through the agencies of contaminated seed, diseased bean refuse and infected soil.

Control

1. Use seed obtained only from disease-free fields.
2. Collect and burn all bean straw. Do not deposit on compost heap or manure pile.
3. Do not grow beans on infected soil for 3 - 4 years.
4. Late planting may reduce susceptibility to blight.
5. Do not work among plants while wet.

HALO BLIGHT OF BEAN



Fig. No. 8. Halo Blight of Bean. Infection on primary leaf of bean. (After Burkholder.)

Cause

Pseudomonas phaseolicola (Burkholder) Dowson.

Plants Attacked

Field and garden bean, scarlet runner bean and lima bean.

Symptoms

Leaves, stems, pods and beans are attacked. The leaves become crinkled and mottled with light and dark green areas. Definite brown spots may be present which are surrounded by light colored halos or borders. Reddish, necrotic areas are found on the stems, from which a grey, or silvery colored exudate appears. Rapidly spreading, irregularly shaped, brown to red spots are found on the pods. If the bacteria penetrate to the seed, small spots are formed and when the disease is severe, affected seeds may be small and wrinkled. The disease also may cause dwarfing and wilting; the leaves become wilted and brown, the pods are withered and no seed may be formed. The bacteria overwinter principally on the seed. In many respects the disease resembles Bacterial Blight of Bean.

Control

1. Plant seed from disease-free sources.
2. Burn all diseased bean refuse.
3. Do not plant beans on infected soil for 3 - 4 years.

BACTERIAL SPOT OF CABBAGE AND CAULIFLOWER



Fig. No. 9. Bacterial Spot of Cabbage and Cauliflower. Leaf spots on cauliflower leaves.
(After McCulloch.)

Cause

Pseudomonas maculicola (McCulloch) Stevens.

Plants Attacked

Cabbage, cauliflower.

Symptoms

This disease causes spotting or blotching of the leaves. The spots develop from water soaked areas to definite lesions, brownish to purplish-grey in color and about $\frac{1}{8}$ inch in size. When spotting is severe the spots may join together to form large irregular diseased areas which turn yellow and fall out, leaving a ragged appearance. Diseased leaves may fall off entirely. Where veins or midribs are attacked, the leaves may become puckered and distorted. Spots also may occur on leafstalks. Older leaves are not so susceptible to attack. Bacteria gain entrance largely through pore openings on the underside of the leaf.

Control

1. Avoid splashing leaves of young seedlings.
2. Collect and burn diseased leaves.
3. Practise a suitable rotation.



Fig. No. 10. Bacterial Wilt (Black Rot) of Cabbage. 1 — Infection on leaves. 2 — Field of cabbage showing the disease in various stages of development. (After D. H. Jones.)

BACTERIAL WILT (BLACK ROT) OF CRUCIFERAE

Cause

Xanthomonas campestris (Pammel) Dowson.

Plants Attacked

Cabbage, cauliflower, brussel sprouts, turnip, kale, rape, radish and other related plants.

Symptoms

Infection may take place at any time from the seedling stage to the mature plant. The first symptom is a yellowing of a part of the leaf, followed by a blackening of the veins. The diseased area becomes thin and brown, with the blackened veins standing out clearly. Infected leaves may fall. On petioles the blackened veins show as dark stripes. On turnips, cut sections show blackened bundles from which bacteria ooze in masses. Plants may become dwarfed and misshapen; small and imperfect heads may result on cabbage and cauliflowers, and stunted roots may be found on turnips. Infected plants are readily attacked by other secondary organisms, resulting in rapid rotting of the plant.

The bacteria gain entrance generally through water pores on the margin of the leaves. They make their way into the vascular system and choke off the food supply from the rest of the plant. The bacteria overwinter in infected leaves, stems, roots and seeds, and are carried from plant to plant by cabbage butterflies, aphids and slugs.

Control

1. Treat seed with corrosive sublimate 1:1000 (1 tablet in 1 pint of water, or 1 oz. in 6 gals. of water) for 30 mins. or with an organic mercury dust.
2. Do not grow susceptible host plants on infected soil for at least 4 years.
3. All weeds of the mustard family should be destroyed and all diseased crop refuse should be gathered and burned.
4. Spray to eliminate slugs and insects.
5. Pull up and destroy all plants showing signs of the disease.
6. Do not hoe or cultivate plants when wet.
7. Do not store infected turnips, cabbages, etc.

BACTERIAL BLIGHT OF CARROT



Fig. No. 11. Bacterial Blight of Carrot. 1 — Carrot leaf showing blighting of segments. 2 — Leaf segment showing disease along the margins. (After Kendrick.)

Cause

Xanthomonas carotae (Kendrick) Dowson.

Plants Attacked

Carrot.

Symptoms

Leaves, petioles, stems and floral parts are affected. Small, irregularly shaped spots occur on the leaf segments, which in a few days become dark brown, dry and brittle and often are surrounded by a yellow border. Infection may take place along the margin of the leaf segments, causing darkening and curling of the leaflet. If the disease is confined to the tips of the segments, they usually are killed. Many lower leaves are blighted and dry up. When severe, the infection extends to the petiole and stem, producing dark brown patches, from which bacterial exudate collects.

Early, severe attack may weaken the plant so that seed may not be produced. While the disease on stems and leaves may weaken the plant, the chief damage is to the flowers; all, or a portion of the flowers may be blighted. This may be serious enough to retard or prevent seed development. Soil and seed are regarded to be the chief sources of infection.

Control

1. Obtain seed from disease-free fields.
2. Burn infected refuse.
3. Sterilize or change greenhouse soil.
4. Do not plant carrots on the same land for 2 - 3 years.

BACTERIAL LEAF SPOT OF CELERY



Fig. No. 12. Bacterial Leaf Spot of Celery. Typical spots on leaflet. (After Jagger.)

Cause

Pseudomonas apii Jagger.

Plants Attacked

Celery.

Symptoms

This disease occurs on most varieties of celery grown. It appears as rusty brown spots, irregular in outline, varying in size from pin point to less than $\frac{1}{4}$ inch in diameter. The spots may be found on all parts of the leaf, but rarely are found on the petioles. When numerous, the spots may cause the death of the older leaves. Unless severe, however, the disease usually disfigures the foliage, which may result in possible reduction in growth of the plants. The bacteria gain entrance through stomates or insect punctures.

Control

1. Burn celery refuse.
2. Practise a suitable rotation.
3. Spray with Bordeaux 4-4-40 (4 lbs. bluestone, 4 lbs. fresh hydrated lime and 40 gals. of water) at intervals of 7 - 10 days.

BACTERIAL WILT OF CUCUMBER



Fig. No. 13. Bacterial Wilt of Cucumber. Wilting of leaves, stems and fruit. (After D. H. Jones.)

Cause

Erwinia tracheiphila (E. W. Smith) Holland.

Plants Attacked

Cucumber, squash, melon, pumpkin and other related plants.

Symptoms

The symptoms first appear as a sudden wilting of the plant, the leaves and vines losing their turgidity and green appearance. Dull, green flabby patches appear which rapidly spread, and are followed by general wilting. The vines finally become dried and shrivelled. The fruit also may wilt, becoming soft, flabby and finally shrivelled. The bacteria invade the vascular bundles and when an infected stem is cut, the contents of the vessels exude in stringy white drops in which masses of bacteria are present. Other types of wilt, caused by injury to the root or lack of moisture, do not exhibit the milky white exudate.

The bacteria enter the plant through insect punctures and are carried from plant to plant by the striped and twelve spotted cucumber beetle, which feed on the plant and inoculate it with the disease bacteria. The bacteria overwinter in the alimentary tract of the beetles.

Control

1. Remove diseased plants and burn as soon as they are observed.
2. Control cucumber beetles by dusting with derris powder, or with a mixture of 5 lbs. of calcium arsenate and 75 lbs. of gypsum or talc.
3. Do not plant susceptible host plants in soil on which the disease has been present for at least 3 years.

ANGULAR LEAF SPOT OF CUCUMBER

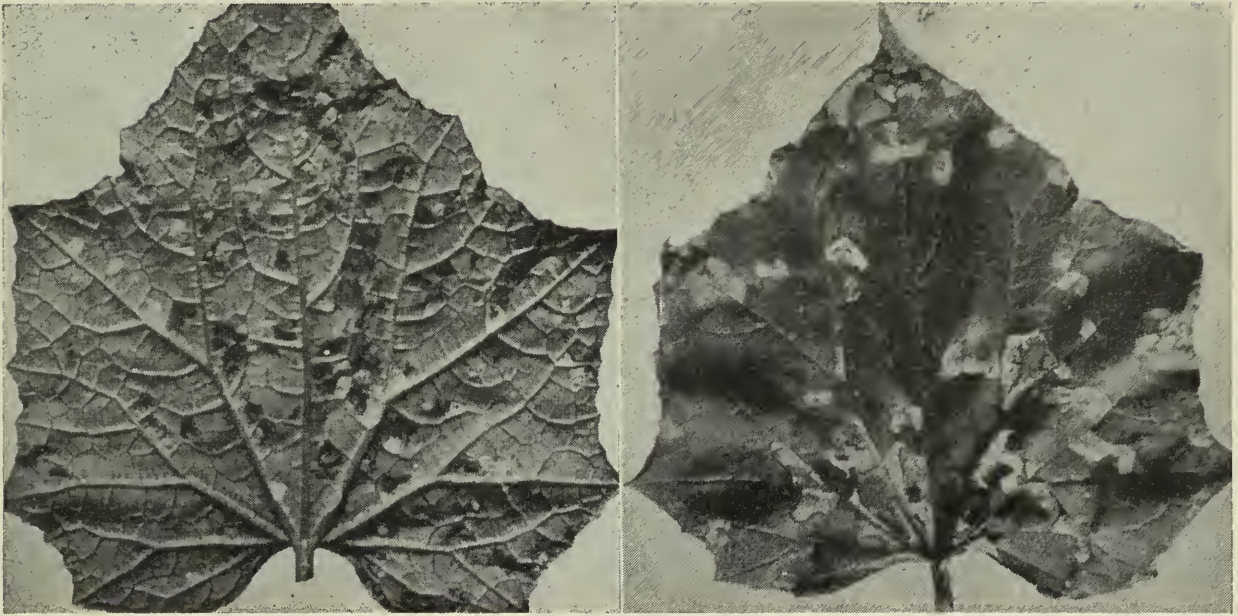


Fig. No. 14. Angular Leaf Spot of Cucumber. Leaves showing infection on lower and upper surfaces. (After Bryan.)

Cause

Pseudomonas lachrymans (Smith and Bryan) Carsner.

Plants Attacked

All varieties of cucumber and ornamental gourds.

Symptoms

The disease affects leaves, stems, fruit and flowers. The spots on the leaves arise from stomatal infection and also from injuries by insects, particularly the cucumber beetle. The spots are angular in outline and brown in color and where many spots join together, large irregular holes may develop giving the leaves a ragged appearance. Frequently a whitish ooze collects in drops on the undersurface of the leaves. Petioles and young stems become softened and may crack or bend over and a white ooze may exude from the spots. On the fruit, the spots are small and circular with white centres from which the exudate appears. Secondary organisms may enter the affected fruit and cause rot. Affected blossoms do not set but become blackened and die.

The disease is spread by rain, insects, contaminated seed and refuse.

Control

1. Pull and destroy affected plants; burn diseased vines.
2. Control insects by proper spraying methods.
3. Practise a suitable rotation.
4. Treat the seed with corrosive sublimate, 1:1000 (1 tablet in 1 pint of water, or 1 oz. in 6 gals. of water) for 5 minutes.
5. Spraying with Bordeaux 4-4-40 (4 lbs. blue-stone, 4 lbs. fresh hydrated lime and 40 gals. of water) when the disease appears in the field checks its spread.



Fig. No. 15. Bacterial Blight of Pea. 1 and 2 — Disease on pods. 3 — Bacterial ooze on diseased stems. 4 — Diseased mature seeds. 5 — Spots on leaves. (After Skoric and Ludwig.)

BACTERIAL BLIGHT OF PEA

Cause

Pseudomonas pisi Sackett.

Plants Attacked

Field and garden pea, sweet pea, everlasting pea and certain members of the cowpea family.

Symptoms

The disease affects leaves, stems, flowers and pods. It appears on the leaves as irregularly shaped spots which enlarge and become a russet brown color. Heavy infection will cause leaf and petiole to become generally brown, thin and shrivelled. Lesions may be plentiful on stems, and occur as olive-brown, elongated spots from which droplets of a pale yellow exudate may appear. The stems eventually may become dark and shrivelled. Infection may spread to the flowers and young pods may shrivel and decay.

More mature pods show irregularly shaped spots, somewhat cracked and cankerous in appearance. Heavily infected pods become thin and shrivelled. Droplets of pale yellow exudate, containing masses of bacteria, collect on the pod lesions. The bacteria may penetrate through the pod, infecting the seed and causing spots to appear, which later may cause the seeds to be dark and shrivelled. Occasionally the seeds may only be covered with the bacterial slime, which, when dried harbors the bacteria for at least 10 months. Plants, affected when young, may wilt and die outright.

The bacteria enter the plant through pore openings and wounds produced by mechanical injury. The bacteria overwinter on infected seed and diseased vines.

Control

1. Gather and burn infected vines.
2. Avoid mechanical injury to plants.
3. Avoid planting peas on infected land for at least 2 - 3 years.
4. Late planting may reduce the amount of disease.

BACTERIAL ROT OF LETTUCE



Fig. No. 16. Bacterial Rot of Lettuce. 1 and 2 — Diseased leaf and diseased areas on heart of lettuce plant. (After Brown, Mehta and Berridge.)

Cause

Pseudomonas marginalis (Brown) Stevens.

Plants Attacked

Lettuce.

Symptoms

This is principally a disease of green house lettuce in which a slight marginal wilting takes place in localized areas on the leaves. The diseased areas vary from small specks to more extensive lesions, but the disease rarely progresses down the entire leaf. At first soft and brown to black in color, affected areas become thin, dry and papery in texture. On older leaves, wilting of the tips is common. Often brownish, water-soaked areas, as well as a speckled appearance are observed below the margins. The disease does not cause extensive rot but spoils the appearance of the leaves for marketing purposes.

The bacteria gain entrance through the stomates, especially at the tips of the leaves, and produce the disease especially on plants that have been weakened by cold, high humidity or excessive watering.

Control

1. Gather and burn infected lettuce leaves.
2. Good ventilation is important.
3. Avoid splashing the plants when watering.

BACTERIAL RING-ROT OF POTATO



Fig. No. 17. Bacterial Ring-Rot of Potato. 1 — Wilt of mature plant. 2 — Interior and exterior of rotted tuber. (After Eddins et al, and Carpenter.)

Cause

Corynebacterium sepedonicum (Spieck and Kotth) Skaptason and Burkholder.

Plants Attacked

Potato.

Symptoms

One of the most destructive diseases of potatoes in Ontario, it appears usually toward the end of the growing season. The first symptoms are wilting and rotting of the leaves, which become mottled, yellow and finally brown. Only one stem may be affected, or all the leaves may be affected. Dwarfing and stunting may accompany wilting of the leaves.

The bacteria enter the tubers through the stem end; light infections may not show any external signs of the disease. Those most seriously affected present a reddish discoloration with cracking of the skin. Cut tubers exhibit stages varying from a light discoloration to extensive rotting. Yellow brown areas are present in the vascular region, which develop into a creamy brown, odorless rot, which at times may be ropy. Secondary saprophytes bring about extensive rot with an offensive odor.

The bacteria are carried on the cutting knife, tubers, graders, sacks and other equipment and usually overwinter on infected tubers.

Control

1. Plant certified seed on land where there has been no signs of the disease.
2. Disinfect tools, bags and equipment in formalin, 1 pint to 40 gals. of water for 2 hours.
3. Do not store infected tubers. Whitewash storage rooms with a whitewash containing 1 lb. copper sulphate to each 10 gallons of whitewash.
4. Notify the Director of Crops, Seeds and Weeds Branch, Dep't. of Agriculture, Toronto, Ontario, if the disease is suspected.



Fig. No. 18. Blackleg of Potato. 1 — Young potato plants showing blackleg infection from seed tubers.
2 — Sections of soft rotting potatoes. (After D. H. Jones.)

BLACKLEG OF POTATO

Cause

Erwinia atroseptica (Van Hall) Jennison.

Plants Attacked

Principally potato, but the disease has been found in artichoke, carrot, parsnip, cucumber, turnip and tomato.

Symptoms

The disease generally makes its appearance in July and may continue until the end of August. The first signs of the disease are a yellowing of the lower leaves, while the upper leaves roll upwards and inwards. The stems grow erect instead of outward, and affected plants become dwarfed, brown and shrivelled. At the base of the plant, at ground level or above, the stem becomes black and rotted. This stem rot is accompanied by considerable slime, and eventually the stem becomes rotted throughout and the upper plant may fall over.

The bacteria enter the tuber at the stem end; they also may enter through pore openings or wounds. A wet progressive rot is produced which is brown or black. Affected tubers may appear sound, but the skin is discolored, indicating rot underneath. When the rot is advanced, the tubers present a shrivelled appearance and the interior is rotted to a soft pulp. "Puddling" of the soil around the affected tubers is common.

The bacteria overwinter in diseased tubers and vines, and are spread by knives, sacks and other materials that have come in contact with the disease. The disease is most destructive in warm, wet seasons.

Control

1. Plant certified seed potatoes.
2. Practise a suitable rotation.
3. Pull and burn affected plants.
4. Do not store affected tubers, and avoid wet storage conditions.
5. Sterilize cutting knife in formalin (one tablespoon in one quart of water).
6. Treat seed tubers before they are cut in formalin (one pint to 25 gals. water) for 2 hours, or by soaking for 10 minutes in a solution made by dissolving 6 oz. of corrosive sublimate in a quart of commercial hydrochloric acid, which in turn is added to 25 gals of water.



Fig. No. 19. Bacterial Soft Rot of Vegetables. 1 — Advanced rot in lower part of iris leaves and corms. 2 — Soft rot in cabbage. 3 — Collapse of celery plant from soft rot. 4 — Badly rotted turnip. (After D. H. Jones.)

SOFT ROT OF VEGETABLES

Cause

Erwinia carotovora (Jones) Holland.

Plants Attacked

Cauliflower, cabbage, celery, lettuce, carrot, turnip, potato, iris, calla lily, onion and many other unrelated vegetables and flowering plants.

Symptoms

This most common and widespread disease causes a wet, slimy and progressive rot of roots, rhizomes, fruit and fleshy stems of vegetables and other plants. The rot varies from grey to brown in color, depending upon the plant attacked. The interior of a plant may be rotted while the tougher epidermis may not be so seriously attacked. In the advanced stage, disintegration may be almost complete, the tissues rotted and the rot accompanied by considerable ooze and a vile odor. Soft rot may appear in the greenhouse, field or storage bin.

The symptoms vary slightly according to the various host plants attacked. In cauliflowers, the flower is more often attacked and the creamy white color changes to a brown, soft character. In turnips and carrots, the bacteria enter near the crown through injuries or slug attack, causing a soft rot that progresses rapidly in warm weather. Celery and lettuce are very susceptible and the symptoms generally start near the tops of young growth, and progress rapidly down stem or leaf, producing a soft mushy rot. The tips of iris leaves wither because of rot in the base of shoots and rhizomes. Tomatoes and other vegetables stored under warm, damp conditions will quickly rot if in contact with rotting tissue.

The bacteria gain entrance through wounds, tissue weakened by contact with the ground, and insect punctures. They overwinter in diseased tissue, plant refuse, soil and manure, and are spread by tools, insects and other means. The disease is always worse in damp warm weather.

Control

1. Pull up diseased plants and burn all infected crop refuse.
2. Practise a long rotation.
3. Avoid wounding plants by careless cultivation.
4. Keep slugs, caterpillars, etc., in check.
5. Dry surface of roots and expose to sunshine before storage.
6. Maintain constant storage temperature of 40°F.
7. Disinfect storage houses with copper sulphate (1 pound in 5 gals. of water) and supply with good ventilation.



Fig. No. 20. Stewart's Disease of Sweet Corn. Affected sweet corn plants, showing dead, white tassels and shrivelled condition of leaves and stems. (After Erw. F. Smith.)

STEWART'S DISEASE OF SWEET CORN

Cause

Bacterium stewartii Erw. Smith.

Plants Attacked

Corn.

Symptoms

This is a wilt disease and the first symptoms usually are light, yellowish green streaks on the leaves, sometimes extending the whole length of the blade. Later the leaves become thin and shrivelled. The whole plant may become affected, resulting in dwarfing and shrivelling. This may occur at any stage of growth but is most common at the time of flowering. The tassels develop prematurely, turn white and die before the rest of the plant.

Considerable yellow gummy exudate accompanies this disease and may glue parts of the plant together, particularly the inner husks and kernels. Dried crusts or bacterial exudate may be found on leaves and other affected parts, and cut sections of stems show an abundance of exudate. The disease may be very uneven in an affected field, healthy plants being found intermingled with affected dwarfed and shrivelled plants.

Excessive moisture favors the spread of the disease which always is worse on low-lying, poorly drained soil. The disease is largely caused by planting infected seed, but certain insects, including the brassy and toothed flea beetle, are known to spread the disease. The bacteria overwinter in, and on seed and in corn refuse. Early varieties of sweet corn, such as Golden Bantam, are particularly susceptible; later maturing varieties are more resistant. Field corn is but slightly affected.

Control

1. Plant only seed from disease-free plants.
2. Seed suspected of being infected should be treated with corrosive sublimate, 1:1000 (1 tablet in 1 pt. of water, or 1 oz. in 6 gals. of water for 20 mins.).
3. Burn infected corn refuse.
4. Plant late maturing varieties.
5. Do not plant corn on infected land for several years.

TOBACCO WILDFIRE

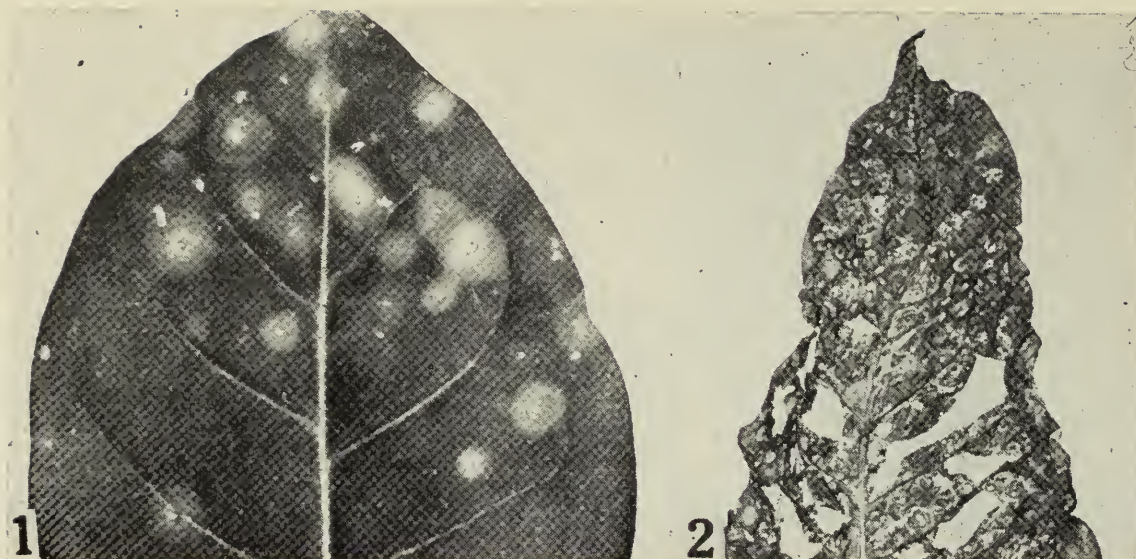


Fig. No. 21. Tobacco Wildfire. 1 — Early stages of infection. 2 — Ragged appearance of leaf during rainy periods. (After F. A. Wolf.)

Cause

Pseudomonas tabaci (Wolf and Foster) Stevens.

Plants Attacked

Tobacco, tomato, eggplant, nightshade and other unrelated plants.

Symptoms

The disease principally affects the leaves. It may occur in the greenhouse or seed bed when the plants are in the seedling stage, where it manifests itself as a wet rot on the margins of the leaves, particularly if the plants are overcrowded and the ventilation poor. Transplants in the field develop leaf lesions, which appear as circular, yellowish green areas. These rapidly enlarge to definite, distinctive spots, tan or brown in the centre and surrounded by a yellowish halo of considerable size. Where the spots are plentiful they may fuse, forming large irregular dead areas, which may rot and break away, giving the leaf a ragged, distorted appearance. Late infections result in only the lower outside leaves being affected. Spots also may occur on stems, flowers and pods.

The bacteria are carried principally on seed and diseased plants, and gain entrance into the pore openings of the leaves. The disease spreads rapidly and is most destructive in warm, wet weather.

Control

1. Treat seed with corrosive sublimate 1:1000 (1 tablet in 1 pt. of water, or 1 oz. in 6 gals. of water) for 15 minutes.
2. Steam sterilize or replace the soil in the greenhouse and disinfect sash, cloth, boards, etc., by soaking in formalin (1 gal. in 50 gals. of water).
3. Avoid overcrowding of seedlings, splashing of water on leaves, and improve ventilation.
4. Spray seedlings at weekly intervals with Bordeaux 4-4-40 (4 lbs. blue-stone, 4 lbs. fresh hydrated lime and 40 gals. of water).
5. Pull and burn infected plants.
6. Practise suitable rotation.

ANGULAR LEAF SPOT OF TOBACCO

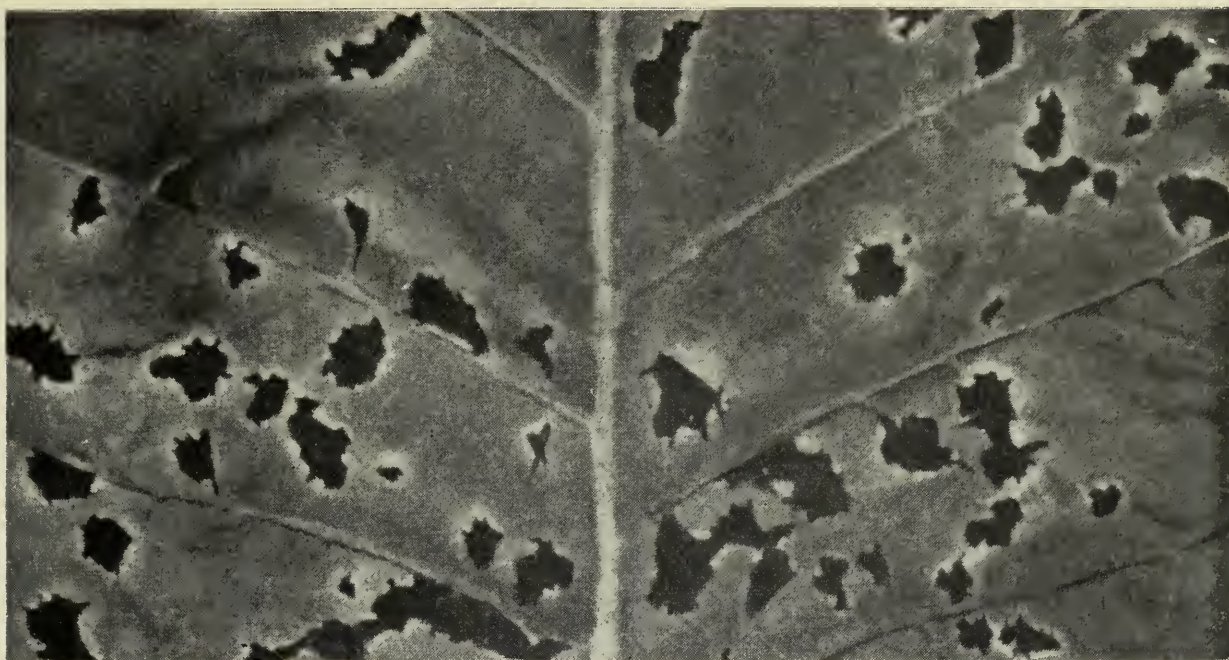


Fig. No. 22. Angular Leaf Spot of Tobacco. Leaf spots on section of tobacco leaf.
(After Fromme and Wingard.)

Cause

Pseudomonas angulata (Fromme and Murray) Holland.

Plants Attacked

Tobacco.

Symptoms

This disease usually is confined to the leaves, although flowers and pods may be affected. Small, angular spots occur on seedlings which become larger and more distinctive on mature plants. The spots are brown to black in color, angular in shape, may attain three eighths of an inch in size and are surrounded by a narrow yellowish border. The centre of the spots may become dry and drop out, leaving irregular holes. Many hundreds of spots may occur on each leaf.

The bacteria gain entrance into the leaves through pore openings, and are spread by rain, wind, infected seed and diseased refuse. Like Tobacco Wildfire, the disease is most destructive in warm, wet weather.

Control

1. Steam sterilize, or replace the soil in greenhouse or seed bed.
2. Treat seed by immersion in corrosive sublimate 1:1000 (1 tablet in 1 pt. of water, or 1 oz. in 6 gals. of water) for 10-15 minutes.
3. Exercise greenhouse sanitation; disinfect cloth, sash, etc., in formalin (1 gal. in 50 gals. of water); avoid splashing of leaves when watering.
4. Spray seedlings at weekly intervals with Bordeaux 4-4-40 (4 lbs. blue-stone, 4 lbs. fresh hydrated lime and 40 gals. of water).
5. Pull and burn diseased plants in greenhouse and field.
6. Do not plant tobacco on infected soil for 2 - 3 years.

WISCONSIN LEAF SPOT OF TOBACCO



Fig. No. 23. Wisconsin Leaf Spot of Tobacco. 1 — Distribution of spots on tobacco leaf.
2 — Enlarged view of leaf section. (After Johnson.)

Cause

Pseudomonas mellea Johnson.

Plants Attacked

Tobacco, tomato.

Symptoms

The disease more commonly affects the lower leaves, and manifests itself as round, brown or rust colored spots, which may be surrounded by a chlorotic area or halo. The spots may be limited by the veins or follow them, forming elongated spots. Where spots are joined together, large irregular areas may be involved. Old lesions usually are brownish white. The disease appears on plants in the seed bed as smaller and more angular spots.

The disease ordinarily starts in the seed bed, from which transplants spread the disease in the field.

Control

1. Change the soil in the seed bed.
2. Practise a suitable rotation.
3. Do not use plants from infected seed beds for transplanting.

BACTERIAL WILT (BROWN ROT) OF SOLANACEAE



Fig. No. 24. Bacterial Wilt of Solanaceae. 1 — Potato plant in early stages of wilt. 2 — Sections of tubers affected with brown rot. (After Meyer and Link.)

Cause

Pseudomonas solanacearum Erw. Smith.

Plants Attacked

Potato, tobacco, tomato, egg plant, nasturtium and many other unrelated plants.

Symptoms

This is a wilt disease, the bacteria finding their way into the vascular system and producing dwarfing, wilting and shrivelling of the foliage. The leaves may change in color to brown or black and sometimes show dark colored veins. The stems show dark patches, and the interior of the stems are brown, with the pith often affected with a brown rot.

In the case of the potato, the tubers are attacked through the stolons. A brown to black rot is formed which extends from the vascular ring. Rotted cavities are present and the whole tuber may become rotted. Brown patches may be seen on the surface of the tubers.

The bacteria gain entrance almost entirely through wounds in roots, stems and leaves made by insects, cultivators, etc. The bacteria live in the soil for several years and overwinter in the refuse of diseased plants. The disease is more destructive in wet seasons.

Control

1. Steam sterilize or change the soil in the greenhouse.
2. Spray young plants at weekly intervals with Bordeaux 4-4-40 (4 lbs. blue-stone, + lbs. fresh hydrated lime and 40 gals. of water).
3. Burn all diseased refuse.
4. Practise a rotation of crops from which susceptible host plants are excluded for at least 5 years. Best results have been obtained by planting corn, wheat, rye, grasses and red clover.

BACTERIAL CANKER OF TOMATO



Fig. No. 25. Bacterial Canker of Tomato. 1 — Wilting of tomato plant. 2 — Loss of color on stems. 3 — Typical canker on stem. (After E. F. Smith.)

Cause

Corynebacterium michiganense (Erw. Smith) Jensen.

Plants Attacked

Tomato.

Symptoms

The bacteria causing this disease penetrate into the vascular system causing a wilt. The symptoms are first noticed on the lower parts of the plant, where wilting, browning and drying of the leaves takes place, followed by the disease progressing upwards. Dead leaves may hang from the petioles and only one side of a plant may be attacked. Yellowish white streaks appear on stems; these may crack open forming characteristic cankers. Cut sections of stems and petioles reveal the presence of reddish brown areas or cavities in the pith.

The bacteria do not produce a rot of the fruit, but if affected when young, the fruit becomes distorted and stunted. Cut sections of fruit reveal the presence of yellowish diseased areas which contain many bacteria. Spots on the fruit appear as small, tan to brown colored areas with a white margin. When plentiful, they form somewhat cankered areas. The seed may become heavily contaminated. Diseased fruit may ripen prematurely.

The disease is spread by contaminated seed and soil and can be carried from plant to plant by workmen and pruning knife.

Control

1. Obtain seed from disease-free plants.
2. Use fresh clean soil in seed beds.
3. Burn tomato refuse.
4. Practise a suitable rotation.
5. Remove diseased plants.
6. Sterilize seed with corrosive sublimate 1:3000 (1 tablet in 3 pts. of water, or 1 oz. in 18 gals. of water) for 5 minutes followed by washing in water for 10-15 minutes.

BACTERIAL SPECK OF TOMATO



Fig. No. 26. Bacterial Speck of Tomato. 1 — Diseased leaves. 2 — Spots on fruit. (After Bryan.)

Cause

Pseudomonas tomato (Okabe) Starr et al.

Plants Attacked

Tomato.

Symptoms

The disease affects fruit, leaves, stems and petioles. On the fruit the spots are very small, raised and dark. They may be many in number and although do not penetrate to any depth, they render the fruit unsightly. The lesions on the leaves are round, brown to black and no larger than on the fruit. When the spots are close together, they form irregular blotches and the adjacent tissue becomes yellow. On stems and petioles the spots tend to be oval in shape. The bacteria gain entrance through injuries and wounded hairs.

Control

1. Gather and burn diseased tomato refuse.
2. Do not plant on land where the disease has been present.

BACTERIAL BLIGHT (SCAB) OF TOMATO AND PEPPER

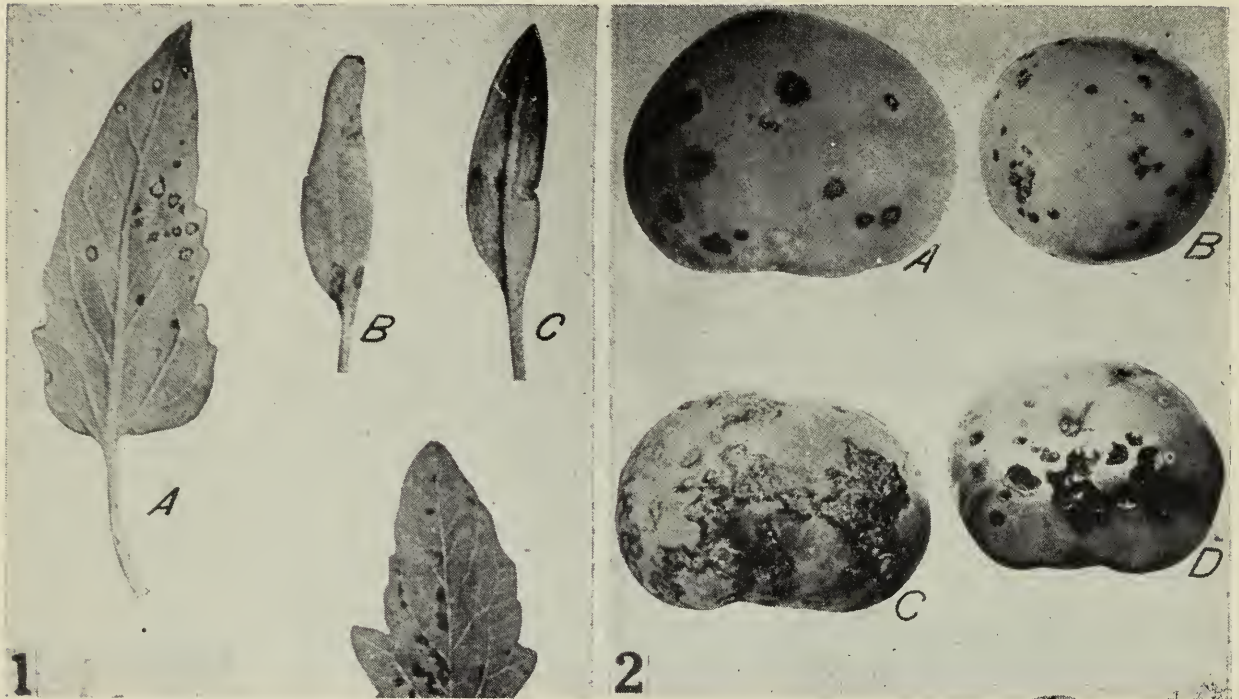


Fig . No. 27. Bacterial Spot (Scab) of Tomato. 1 — Infection on leaves and petioles. 2 — Spots on fruit. (After Gardner and Kendrick.)

Cause

Xanthomonas vesicatoria (Doidge) Dowson.

Plants Attacked

Tomato, pepper.

Symptoms

This is a typical spot disease of fruit, stems and foliage, with the fruit being damaged most severely. The spots on the leaves are small, irregularly circular, with sunken, black centres and a greasy appearance. The leaf may become ragged in appearance where diseased portions have broken away. Heavily infected leaves turn yellow and die. Somewhat elongated cankerous spots occur on stems and petioles.

The spots on the fruit may occur at any point on the surface and appear as small, raised blisters which enlarge to become irregularly shaped scabby areas. The centre of the spot is sunken and dark, and may give rise to a sticky exudate. Spots joined together cause cankered areas without cracking or distortion of the fruit.

The bacteria gain entrance through pore openings, wounds and insect punctures. The bacteria overwinter principally on seed, fruit and vines.

Control

1. Treat seed with corrosive sublimate 1:3000 (1 tablet in 3 pts. of water, or 1 oz. in 18 gals. of water) for 5 minutes, followed by washing in water for 10-15 minutes.
2. Pull and burn infected plants.
3. Practise a suitable rotation.

III. DISEASES OF CEREAL CROPS

BACTERIAL STRIPE BLIGHT OF OATS

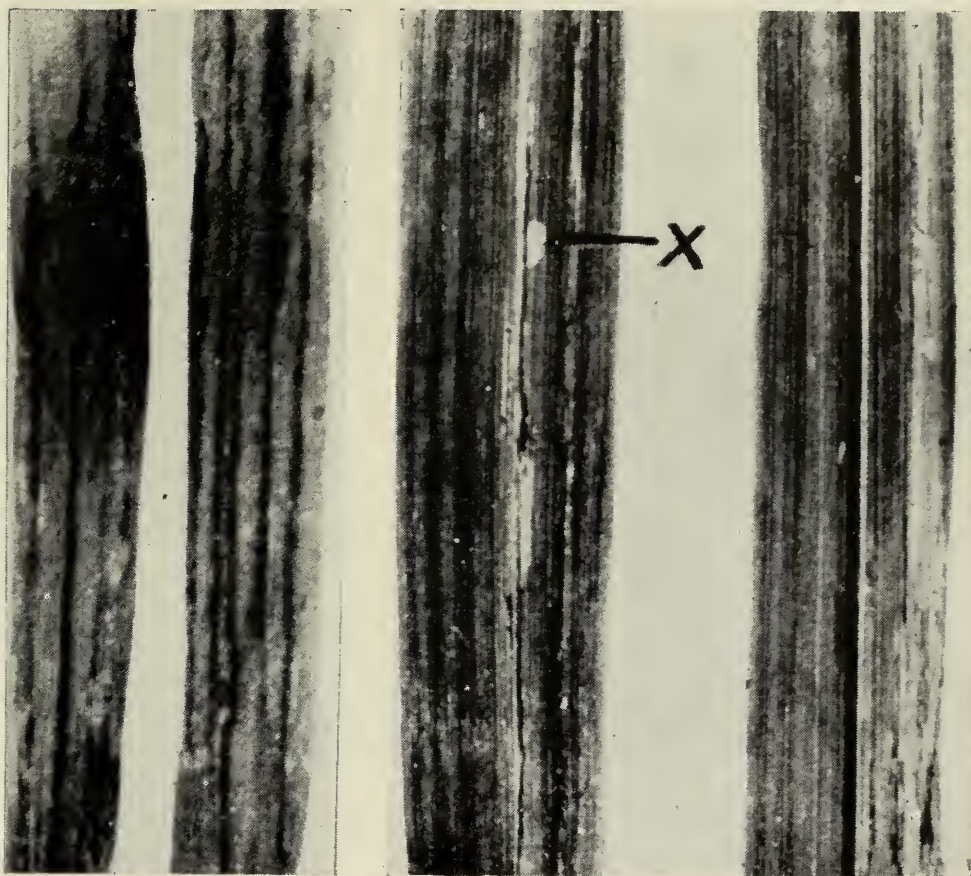


Fig. No. 28. Bacterial Stripe Blight of Oats. Stripe blight lesions and exudate (X) on leaves of oats. (After Elliott.)

Cause

Pseudomonas striafaciens (Elliott) Burkholder.

Plants Attacked

Oats.

Symptoms

Numerous water-soaked spots enlarge and join together to form elongated stripes or blotches. The stripes may vary in length from a fraction of an inch to several inches in length or may extend the full length of the blade. Numerous blotches or stripes, which are rusty brown in color, may cause the collapse of the leaf tissue. Considerable exudate appears which dries into thin white scales. Unlike Halo-Blight of Oats, there is no halo-like border around the lesions.

The disease may attack the plant in all stages of development, and lesions also may be found on sheaths, culms, pedicels and glumes. The bacteria are plentiful in the diseased areas and gain entrance into leaves through the stomates.

Control

1. Obtain seed from disease-free areas.
2. Do not sow seed on land which has grown oats infected with the disease.

HALO-BLIGHT OF OATS

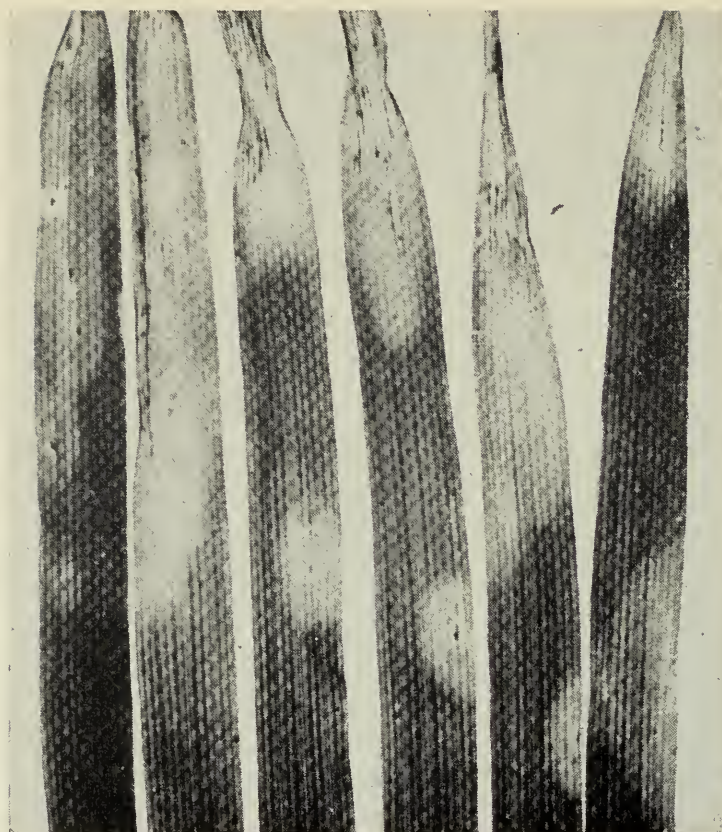


Fig. No. 29. Halo-Blight of Oats. (After Elliott.)

Cause

Pseudomonas coronafaciens (Elliott) Stevens.

Plants Attacked

Oats.

Symptoms

Although the symptoms of this disease are most conspicuous on the leaves, the glumes and leaf sheaths also are attacked. The disease on the leaves occurs as oval shaped spots, consisting of grey-brown, collapsed tissue, surrounded by a chlorotic, halo-like border which becomes yellow. The halo-like margins may be prolonged at one end into points extending as yellow streaks up and down the leaf. Crescent shaped lesions may be found on the margins of the leaves. No exudate occurs. When several lesions occur on the same leaf and are joined together, a general yellowing is produced, followed by the leaf breaking or becoming shrivelled and dry. Distinct halo-like lesions also occur on the glumes.

The bacteria are abundant in the centre of the lesions. They overwinter on the seed, producing primary lesions on the leaves of seedlings. From these lesions the bacteria are carried to other leaves by wind and rain.

Control

1. Obtain seed from disease-free areas.
2. Practise a suitable rotation.
3. Soaking the seed in formalin (1 pt. in 40 gals. of water), for 3 hours reduces the amount of blight.

BACTERIAL BLIGHT OF BARLEY



Fig. No. 30. Bacterial Blight of Barley. (After Jones et al.)

Fig. No. 31. Bacterial Blight of Rye. (After Reddy et al.)

Cause

Xanthomonas translucens var *borderi* Hagborg.

Plants Attacked

Barley.

Symptoms

The first evidence of this disease occurs on the young green leaves, when water-soaked lesions enlarge to become irregular translucent stripes which may extend the full length of the blade and sheath, but terminate at the nodes. The stripes are yellowish brown in color. Blotch-like spots also occur, which may cause portions of the leaf to turn brown and shrivel. Under humid conditions considerable exudate appears as drops that later harden into resinous granules. Lesions also occur on the glumes, and the kernels may be brown and shrunken. If the flag leaf is attacked before the head emerges, the exudate may seal up the sheath and cause the head to be bent and distorted as it emerges.

The bacteria overwinter on the seed and diseased leaves. The bacteria, which are very resistant to drying, gain entrance into the stomates and may be spread to leaves by wind and rain.

Control

1. The use of seed from infected areas should be avoided.
2. Avoid the use of manure from animals fed or bedded on diseased straw.
3. Seed treatment with formalin (1 pt. in 40 gals. of water) for 2 hours assists in controlling the disease.

BACTERIAL BLIGHT OF RYE

Cause

Xanthomonas translucens var *secalis* (Reddy, Godkin and Johnson) Hagborg.

Symptoms

This disease closely resembles Bacterial Blight of Barley, causing the same blotch and stripe lesions on the leaves.

BLACK CHAFF OF WHEAT

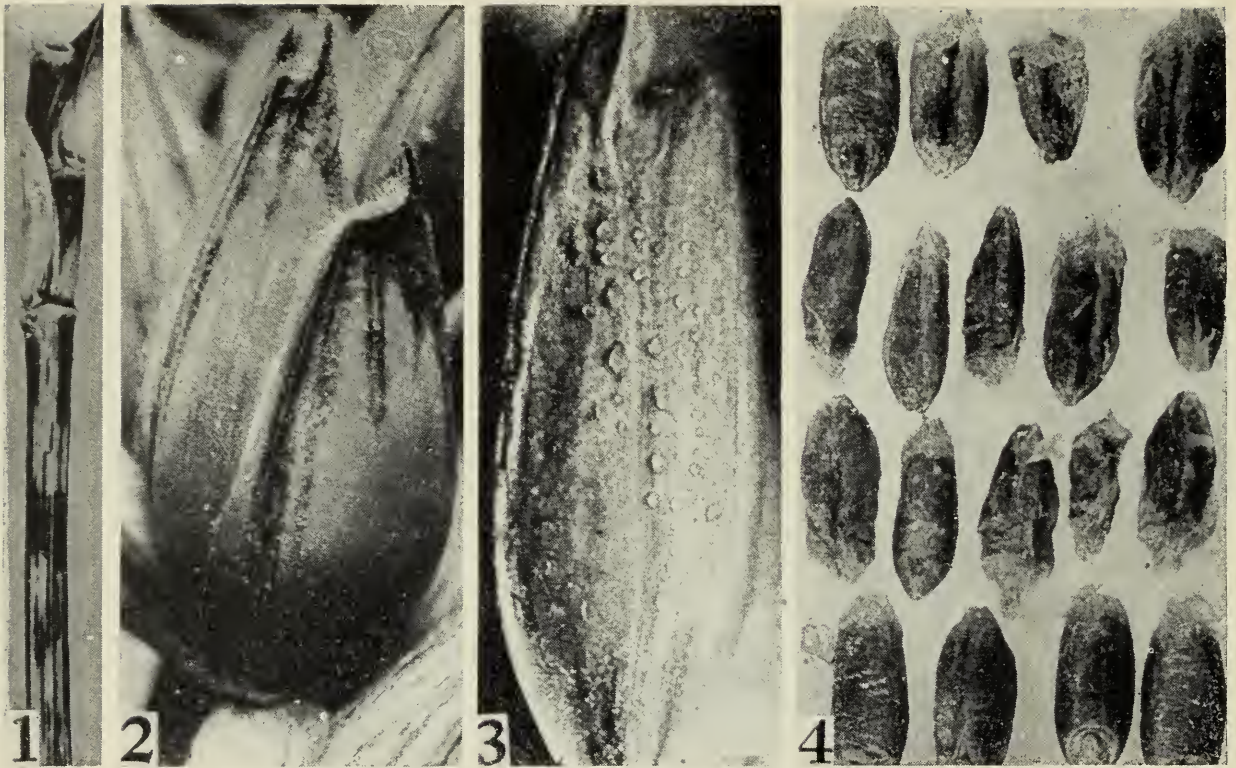


Fig. No. 32. Black Chaff of Wheat. 1 — Section of stem showing black stripes. 2 and 3 — Infected glumes showing stripes and bacterial exudate. 4 — Shrivelled kernels. (After E. F. Smith.)

Cause

Xanthomonas translucens var. *undulosa* (Smith, Jones and Reddy) Hagborg.

Plants Attacked

Wheat, barley, rye, oats and certain grasses.

Symptoms

While the disease affects most parts of the plant, the most conspicuous symptoms are found in the glumes and culms. The symptoms on the leaves appear first as small, water-soaked translucent areas which enlarge to elongated streaks, dark brown to black in color. As the wheat approaches maturity, black stripes appear on the culms, and elongated, sunken stripes are found on the glumes. Considerable exudate may appear which dries to yellow beads. Rachises and stalks also may be conspicuously brown or black-striped. When the disease is severe, the spike may be dwarfed and the kernels shrivelled. Affected kernels may contain cavities filled with bacteria.

The bacteria overwinter in diseased stubble, refuse and seed, and gain entrance into the plant through stomates and wounds.

Control

1. The use of seed from badly infected fields should be avoided.
2. Remove shrivelled kernels from seed wheat by screening.
3. Avoid the use of manure from animals fed or bedded with diseased straw.
4. Treating the seed with formalin will assist in controlling the disease. This consists of soaking the seed for 10 minutes in water, keeping it damp for 6 hours and then dipping for 10 minutes in formalin (1 pint in 40 gals. of water), draining and covering for 6 hours, then drying and planting.

BASAL GLUME ROT OF WHEAT



Fig. No. 33. Basal Glume Rot of Wheat. 1 — Head of wheat showing basal glume rot. 2 — Glumes and kernels blackened by the disease. (After Erw. F. Smith.)

Cause

Pseudomonas atrofaciens (McCulloch) Stevens.

Plants Attacked

Wheat.

Symptoms

The disease affects the leaf, head and grains of wheat. The spots on the leaves, which at first are small and water-soaked, become elongated, dry and light brown in color. Whereas the whole surface of the glume may be affected, usually the lower third of the glume shows brown to black areas, particularly at the base. Occasionally, when there is no exterior sign of the disease, the inner surface of the glume may be darkened.

The grain found in diseased glumes may show various stages of undevelopment. The base, or germ end varies in color from brown to charcoal black, and suggests charring. Bacteria may be present in great numbers in these diseased areas.

The bacteria, which have been known to live on seed for more than a year, usually gain entrance into the stomates.

Control

1. Sow seed obtained only from disease-free areas.
2. Do not sow seed on land on which the disease has been present.
3. Avoid the use of manure from animals fed or bedded on diseased straw.

IV. DISEASES OF FORAGE AND FIBRE CROPS

BACTERIAL BLIGHT OF ALFALFA



Fig. No. 34. Bacterial Blight of Alfalfa. Diseased stems and leaves of alfalfa. (After Sackett.)

Cause

Pseudomonas medicaginis Sackett.

Plants Attacked

Alfalfa.

Symptoms

The disease is principally a stem infection, but leaves also may be attacked. Infected stems present an olive green appearance along one side, from which a glistening exudate appears that spreads over the affected areas in a glistening, varnished-like coating. This resinous coating blackens and hardens with age and the stems become brittle and easily broken. The discolored areas on the stems extends from the surface to the centre, and the interior of the stem presents a brown and mealy appearance. Young plants may show blackened areas in the crown and black streaks extend into the roots.

The leaves attached to a diseased part of the stem appear pale yellow, and may be dwarfed and shrivelled. Occasionally the leaves exhibit the disease independently of the stems, appearing pale, watery and light green in color. An affected field shows alfalfa plants to be short, spindly and off-color. The disease appears to run its course with the first cutting and does not appear until the following year.

Control

1. Secure frost resistant varieties.
2. Clipping of frosted alfalfa as soon as danger of frost is past removes frost-split stems as a source of infection.

BACTERIAL WILT OF ALFALFA

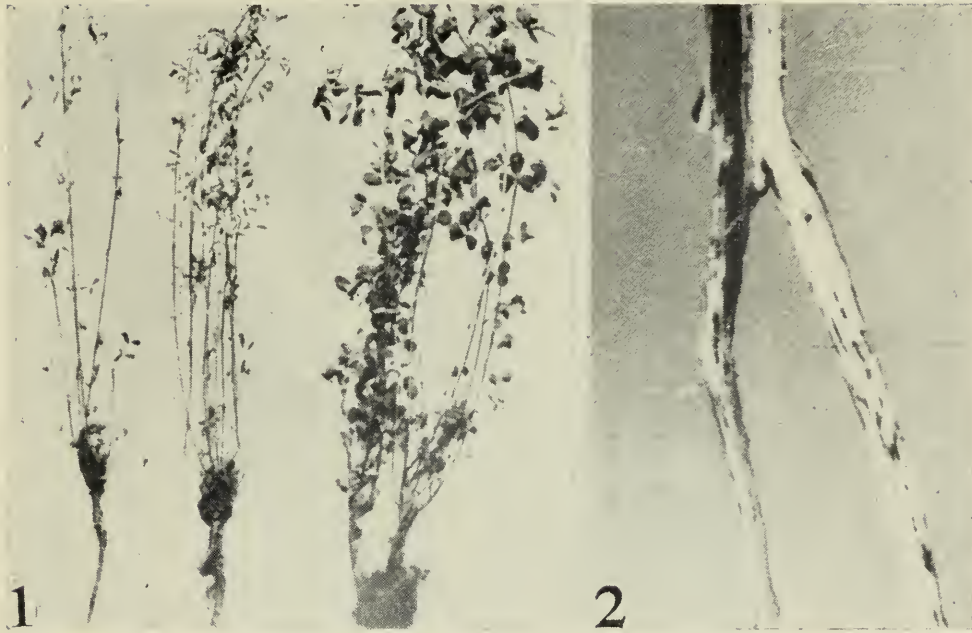


Fig. No. 35. Bacterial Wilt of Alfalfa. 1 — Diseased and healthy plants. 2 — Black streaks on infected root. (After Jones and McCulloch, and Muncie and Megee.)

Cause

Corynebacterium insidiosum (McCulloch) Jensen.

Plants Attacked

Alfalfa, sweet clover.

Symptoms

The most conspicuous symptom of the disease is the wilting of the foliage. The leaves show an upward curling, are smaller in size and become mottled or yellow at the margins. Infected plants often are stunted with small weak stems and dried leaves.

Wilting of the foliage is the result of infection of the tap root, which occurs in the early stages of the disease. The bacteria clog the vascular system and infection in the tap root is shown by yellowish to brown streaks extending into the woody portion of the root. A yellowish slime may accompany these symptoms. In the later stages of the disease, the root may become decayed and invaded by other rot organisms.

The bacteria are carried in dust from broken infected stems adhering to the seed. They enter the outer portions of the root through wounds, made by insects, freezing etc. The disease is spread in the field by surface drainage water and also by the mower knife during cutting.

Control

1. Allow sufficient time for old infected alfalfa roots to decay before re-seeding to alfalfa.
2. Sow hardy varieties from approved sources.
3. Cut alfalfa plants when dry.
4. Use manure from infected hay on fields planted to other crops than sweet clover or alfalfa.
5. Seed alfalfa on fields located so as not to receive surface drainage from infected fields.

BACTERIAL SPOT OF BROME GRASS

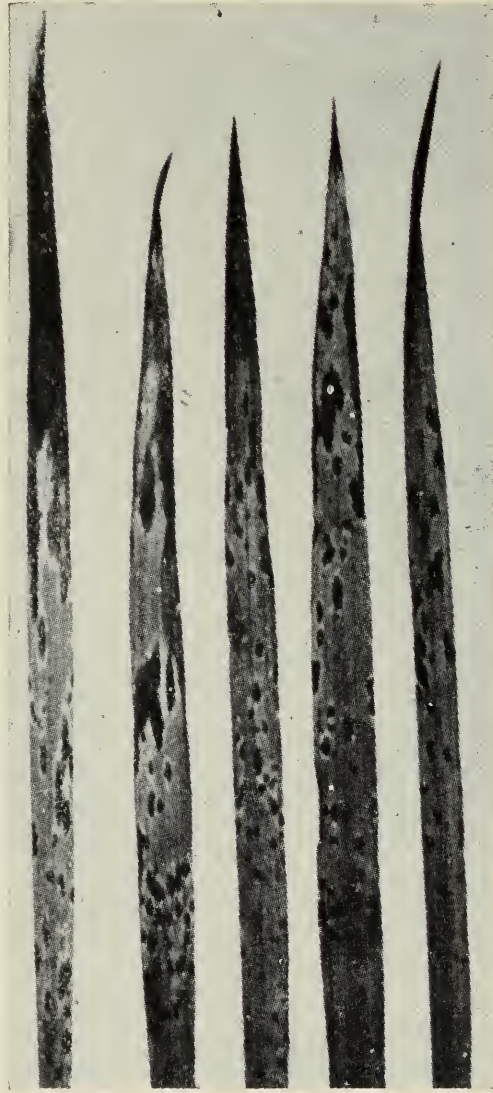


Fig. No. 36. Bacterial Spot of Brome Grass. Spots on leaves. (After Reddy and Godkin.)

Cause

Pseudomonas coronafaciens var *atropurpureum*. (Reddy and Godkin) Stapp.

Plants Attacked

Brome grass and quack grass.

Symptoms

The disease appears on leaves and glumes at first as olive green, circular to elliptical spots with light brown centres. Later the spots become purplish brown to black in color, and in the early stages of the disease, may be surrounded by yellow halos. Old lesions are elongated and may join together to destroy the entire surface of the leaf. Upper nodes are sometimes killed and the panicles may wither and die.

The seed may become infected by coming in contact with lesions on the upper leaves at the time the panicles emerge. The bacteria overwinter on dead brome grass and it is thought that the disease is transmitted on the seed. The bacteria gain entrance through wounds and stomates.

Control

No control measures advocated except that brome grass should not be sown on land where the disease has been present.

BACTERIAL LEAF SPOT OF BROOM CORN AND SORGHUM



Fig. No. 37. Bacterial Leaf Spot of Broom Corn and Sorghum. Spots on leaves. (After Kendrick.)

Cause

Pseudomonas holci Kendrick.

Plants Attacked

Broom corn, sorghum, sudan grass, dent corn, sweet corn, foxtail.

Symptoms

This is a spot disease, occurring mainly on the leaves. The symptoms differ slightly on the various host plants, but generally appear first as dark green, water soaked lesions, elliptical to linear in shape. Later, they become brown or reddish centred with reddish margins and a yellowish halo. Marginal infection is common on the lower leaves, and spots usually are more numerous toward the tips. Where spots are numerous, large necrotic areas are formed and the vitality of the plant may be impaired.

The bacteria overwinter in or on the seed or sorghum and also in the soil. They gain entrance into the plant through the stomates on the leaves; infection is most severe in warm, damp weather.

Control

1. Practise clean cultivation and destroy susceptible volunteer crops.
2. Select seed from disease-free fields.
3. Infected land should not be planted to susceptible host plants for at least two years.

BACTERIAL STALK ROT OF CORN

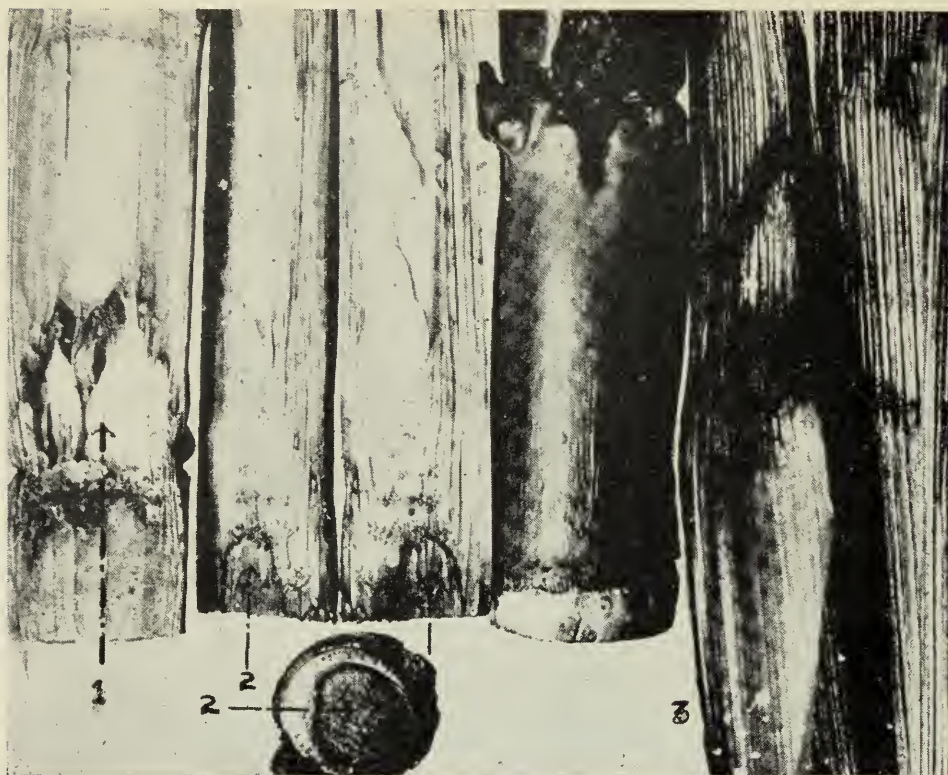


Fig. No. 38. Bacterial Stalk Rot of Corn. 1 — Internal pocket of dry rot. 2 — Wet rot stage. 3 — Infected sheath. (After Rosen.)

Cause

Erwinia dissolvens (Rosen) Burkholder.

Plants Attacked

Corn.

Symptoms

The disease affects the lower part of stalks and leaves. Rotting and premature dying of the lowermost leaves take place in the parts joining the stem. Affected leaves and husks show brown spotting, followed by yellowing and withering.

In the stalks, the disease occurs as a rot in a lower node generally immediately above the soil line. The rotted part is brown to black in color, soft, and with a strong odor of decay. Considerable greyish slime accompanies the rot. In some cases the disease is confined to localized pockets extending into the interior; in others the rot may involve the whole circumference of the stem. In severe cases complete rotting of the lower node may be followed by falling over of the stalk. Infected tissue dries into easily disjointed, shredded fibres.

The bacteria are found in great numbers in the rotted portions of the stem. They gain entrance into corn plants through injuries, water pores and stomates. The disease develops rapidly in warm, damp weather.

Control

1. Do not plant corn on land where the disease has been present.
2. Avoid injuries to plants by careless cultivation and hoeing.
3. Diseased plants should be removed and burned.

BACTERIAL STRIPE DISEASE OF SORGHUM

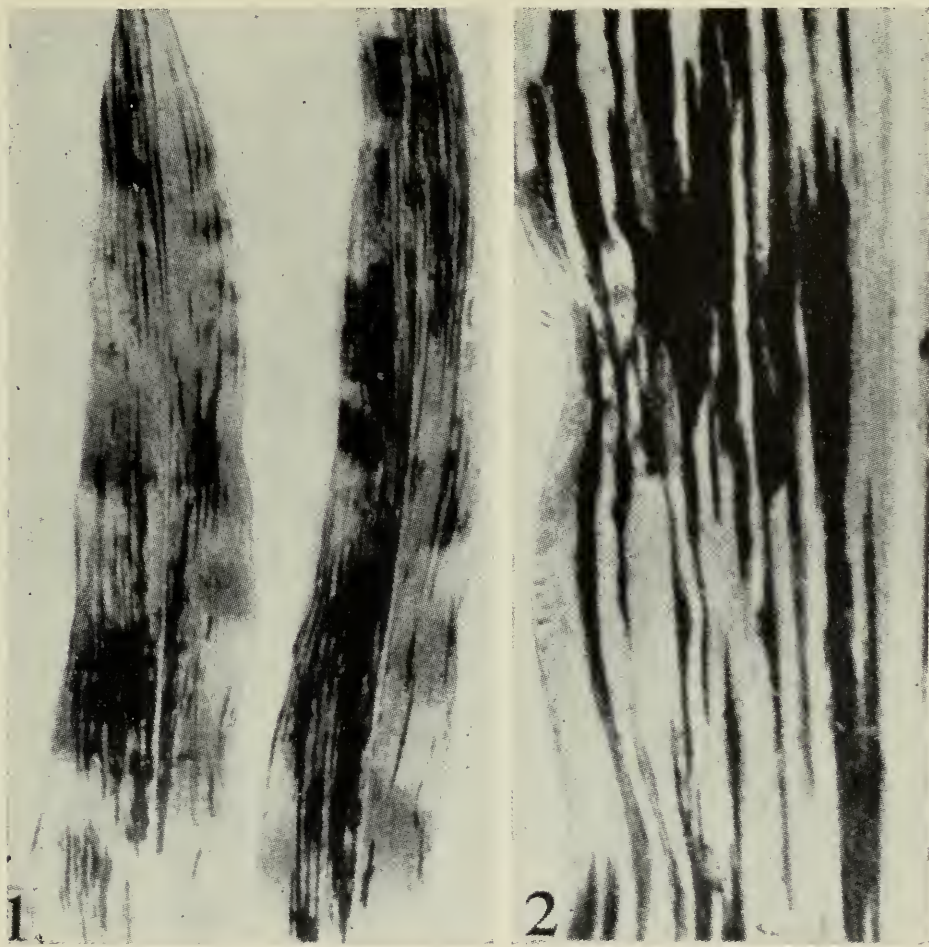


Fig. No. 39. Bacterial Stripe Disease of Sorghum. 1 — Dark red lesions on sorghum. 2 — Enlarged view of streaks on sorgho leaf. (After Elliott and Erw. Smith.)

Cause

Pseudomonas andropogoni (Erw. Smith) Stapp.

Plants Attacked

Sorghum, sudan grass, broom corn.

Symptoms

This disease affects the leaves and sheaths, causing rather distinctive streaks and blotches. The streaks vary in color from tan to red and even purple, depending upon the plant attacked. They extend as long, narrow lesions between the veins and usually end in long, jagged points. Where plentiful, they may join together, affecting a considerable portion of the leaf. There is an abundance of bacterial exudate, usually found on the undersurface of the leaf, which dries in reddish crusts or scales. Although not abundant on the leaves, the streaks may extend to sheaths and stalks.

It is probable that the bacteria are carried over on the seed. They gain entrance into the plant through stomates and wounds. The disease is most severe in warm, damp weather.

Control

1. Burn infected refuse.
2. Obtain seed from disease-free fields.
3. Practise a suitable rotation.

BACTERIAL BLIGHT OF SOYBEAN



Fig. No. 40. Bacterial Blight of Soybean. 1 — Disease on the leaves. 2 — Lesions on pods and stems. (After Coerper.)

Cause

Pseudomonas glycinea Coerper.

Plants Attacked

Soybean.

Symptoms

The disease may be found on both seedlings and mature plants. On young seedlings, lesions occur on the margin of the leaves, which turn brown, become withered and may be followed by the death of the seedlings. On the leaves of mature plants, the spots are small, angular in shape and dark brown in color. The spots may join together, causing irregularly shaped, blotchy diseased areas. Older lesions become reddish brown to black in color. Considerable exudate collects in a thin film on the underside of the leaves. Leaf tissue adjacent to infected areas may turn yellow in color. Lesions on petioles and stems may be quite extensive and are dark brown to black in color.

Spots on the pods develop from small water-soaked areas to larger, irregular lesions, involving considerable portions of the pod. The spots turn dark brown to black in color and the exudate dries to brownish scales. If the bacteria penetrate the pods, the seeds may become infected and covered with a slimy bacterial exudate.

Infected seed is believed to be the chief means by which the disease is carried and by which it is introduced into new localities. It also is possible for the bacteria to overwinter in the diseased leaves. Splashing rain spreads the disease in the field.

Control

1. Avoid the use of infected soil.
2. Use seed only from disease-free pods.

V. DISEASES OF FLOWERS AND ORNAMENTAL PLANTS

BACTERIAL LEAF SPOT OF BEGONIA

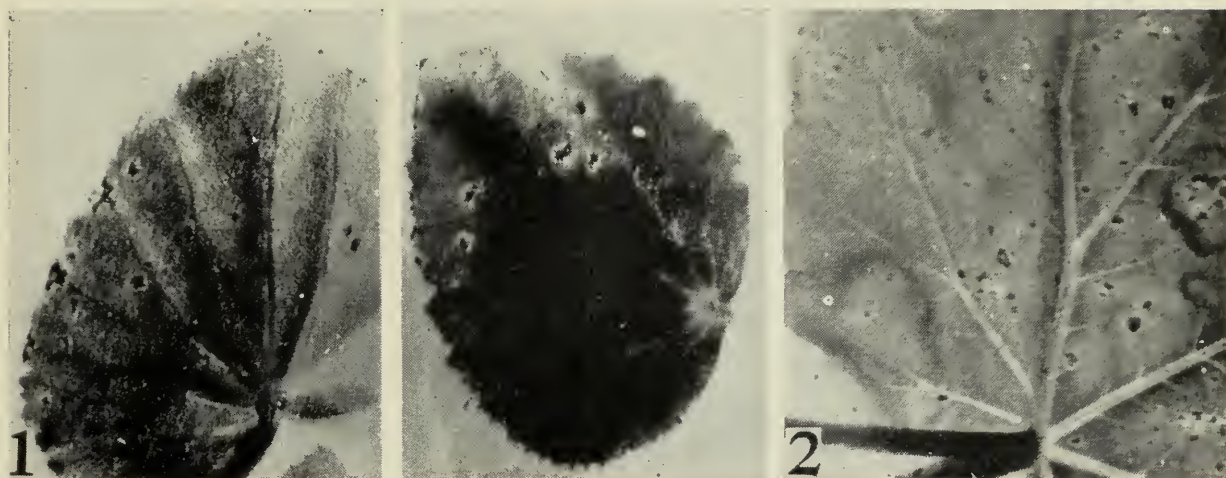


Fig No. 41. Bacterial Leaf Spot of Begonia. 1 — Infection on leaves. 2 — Enlarged view of infected leaf. (After McCulloch.)

Cause

Xanthomonas begoniae (Takimoto) Dowson.

Plants Attacked

Begonia.

Symptoms

The disease first occurs as tiny clear specks on the underside of the leaves. These enlarge to become roughly circular, pale green areas which eventually turn brown with yellow halos. The spots generally are distributed over the leaf, but may be more numerous along the margins. Seldom are petioles or veins attacked. Under warm, damp conditions, the spots may enlarge and join together, causing large areas of infected tissue which show soft rot. Attacked leaves become unsightly, and when the disease is severe, defoliation may result.

The bacteria enter through the stomates on the underside of the leaves. Warm, moist, poorly ventilated and crowded conditions favor spread of the disease.

Control

1. Remove and destroy affected leaves.
2. Avoid crowding of plants.
3. Reduce moist humid conditions by controlled ventilation.
4. Avoid splashing the leaves from the soil when watering.

BACTERIAL LEAF SPOT OF CARNATION

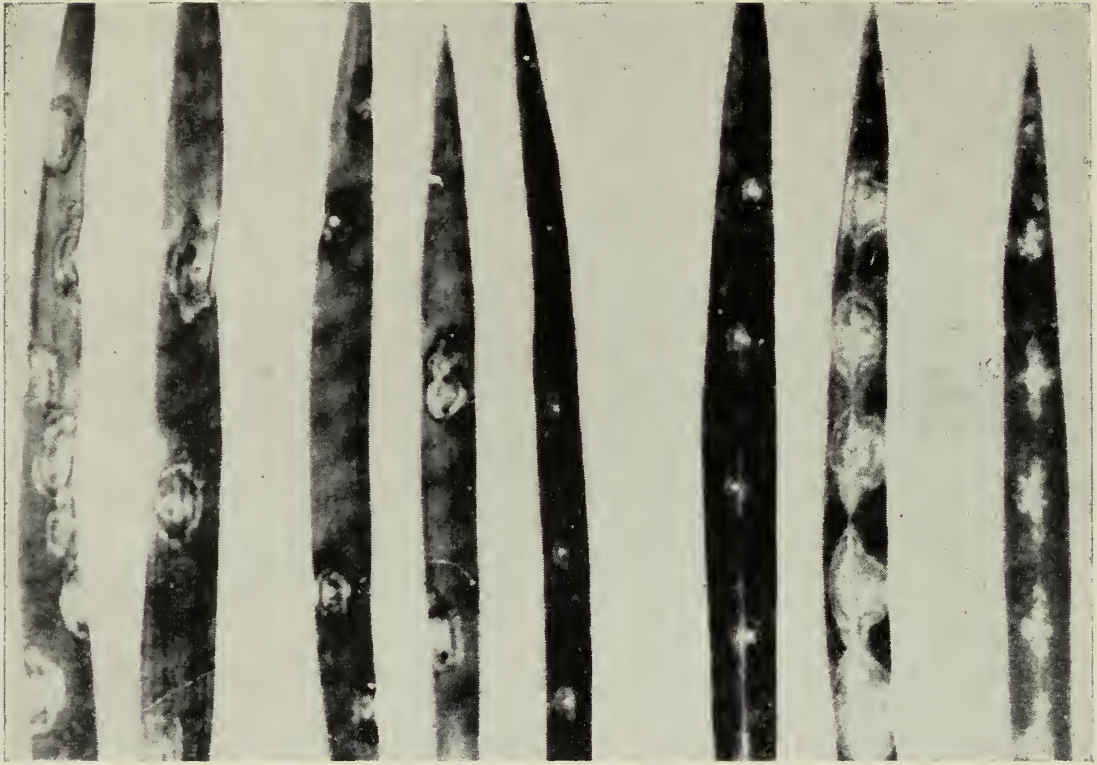


Fig. No. 42. Bacterial Leaf Spot of Carnation. Natural infection on leaves.
(After Burkholder and Guterman.)

Cause

Pseudomonas woodsii (Erw. Smith) Stevens.

Plants Attacked

Carnation.

Symptoms

This is principally a foliage disease, but occasionally stems and flower buds may be attacked. The spots on the leaves are sunken and oval in shape. They are pale brown in color with purplish concentric zones and yellowish borders. Under excessive humidity, drops of exudate may be found oozing from the lesions. Numerous spots tend to join together, affecting large areas of leaf surface.

Numerous spots generally cause the leaf to turn yellow, shrivel and die, with the spots assuming a rusty brown color. The disease progresses from the lower leaves upwards and when severe, flower production may be curtailed or arrested.

The bacteria gain entrance through wounds and insect punctures. The disease spreads rapidly under high temperatures.

Control

1. Destroy diseased plants and practise sanitary measures.
2. Maintain greenhouse temperature and humidity as low as possible.
3. Application of sulphur dust assists in controlling the disease.

BACTERIAL LEAF SPOT OF DELPHINIUM



Fig. No. 43. Bacterial Leaf Spot of Delphinium. Various types of spots on leaves. (After Bryan.)

Cause

Pseudomonas delphinii (Erw. Smith) Stapp.

Plants Attacked

Delphinium.

Symptoms

The disease is first noticed as small spots with water soaked edges. These enlarge to become rather striking, tarry black areas of irregular shape, and varying in size from pin point to $\frac{1}{2}$ to $\frac{3}{4}$ inches in length. They may occur on any part of the leaf and are quite common on the leaf tips. Infection on young leaves usually causes distortion. On vigorous healthy plants the spots are larger than on less healthy specimens. Flower buds may be attacked, becoming black spotted and distorted. Stems also may be attacked.

The bacteria gain entrance through the stomates on the underside of the leaf, and also through the water pores at the tips of the leaves. It is probable that the bacteria overwinter in the soil.

Control

1. Gather all diseased material and burn.
2. Spray both soil and early leaves with Bordeaux 4-4-40 (4 lbs. blue-stone, 4 lbs. fresh hydrated lime and 40 gals. of water).

BACTERIAL LEAF SPOT OF GARDENIA



Fig. No. 44. Bacterial Leaf Spot of Gardenia. (After Burkholder and Pirone.)

Cause

Pseudomonas gardeniae Burkholder and Pirone.

Plants Attacked

Gardenia.

Symptoms

Oval to circular spots occur on the leaves, varying in size from pin-point to $\frac{1}{4}$ " in diameter. The spots are reddish brown in color and are surrounded by a water-soaked margin. Where spots are numerous and join together, yellowing and premature defoliation may result. The spots usually occur on the lower leaves and spread upwards on the plant as the season advances. Infection is more severe on tender leaves, but only small lesions occur on older leaves.

The disease progresses more rapidly under moist, humid conditions, and especially where plants are crowded in the greenhouse.

Control

1. Gather and burn infected material.
2. Avoid overcrowding and allow sufficient ventilation.
3. Avoid splashing from the soil when watering.

BACTERIAL SCAB OF GLADIOLUS

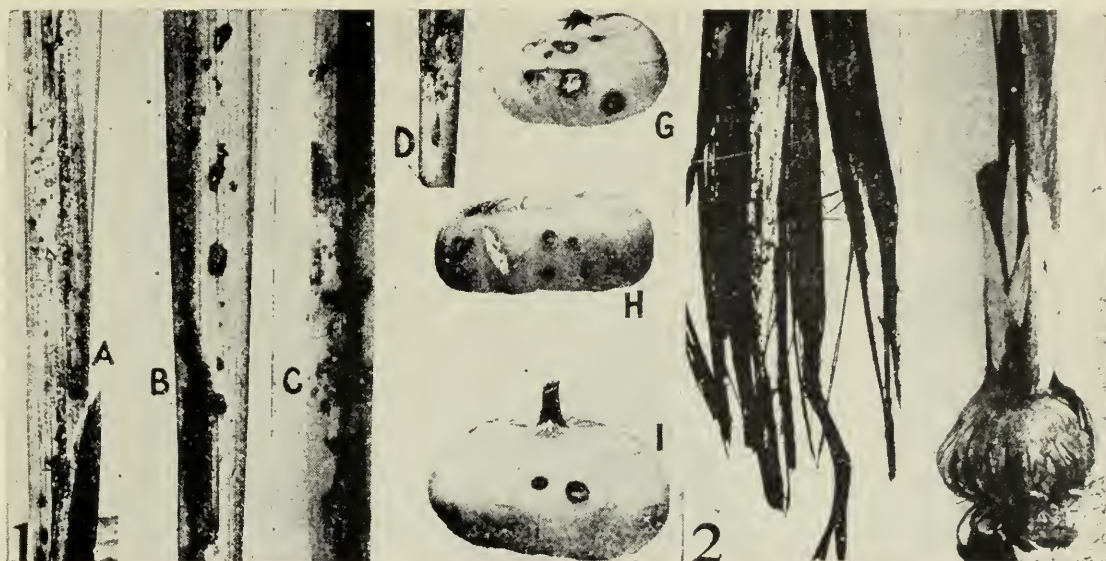


Fig. No. 45. Bacterial Scab of Gladiolus. 1 — Lesions on leaves and corms. 2 — Rotted leaves and corms. (After McCulloch.)

Cause

Pseudomonas marginata (McCulloch) Stapp.

Plants Attacked

Gladiolus.

Symptoms

Although the lesions may appear on any part of the leaf, they are found more commonly on the lower portions. They appear at first as tiny reddish, slightly elevated specks or spots, which enlarge to become somewhat elongated areas, the centres of which are sunken, dark brown or black. These may enlarge and join together, producing large necrotic areas in which the tissue is destroyed. When infection is severe, rotting of the lower part of the stems may take place causing the plants to fall over; this is referred to as "neck-rot".

The spots on the husks are at first pale yellow, but become brown to black. The husk may split longitudinally, disintegrating at the base and may appear burned or scorched. Corm lesions occurring below the husk lesions, also are pale yellow at first but become brown to black with depressed centres and elevated margins. They vary in size from pin-point to $\frac{1}{4}$ inch in diameter and may be covered with a shiny gummy exudate. When the spots are numerous and join together, large, irregular sunken areas are produced. Affected corms may be subject to attack by secondary saprophytes.

The bacteria are known to overwinter in corm, husk and leaf lesions and there is some evidence to believe that they remain alive in the soil.

Control

1. Remove and burn diseased tissue.
2. Discard badly diseased corms.
3. Practise a suitable rotation.
4. Remove husks before planting.
5. Soak the corms in corrosive sublimate 1:1000 (1 tablet in 1 pint of water, or 1 oz. in 6 gals of water) for 30 minutes.

BACTERIAL BLIGHT OF GLADIOLUS



Fig. No. 46. Bacterial Blight of Gladiolus. Various types of spots on leaves. (After McCulloch.)

Cause

Xanthomonas gummisudans (McCulloch) Starr and Burkholder.

Plants Attacked

Gladiolus.

Symptoms

The lesions are first visible on the leaves as narrow, water-soaked spots which develop into more or less regularly formed rectangular areas. At first green, the spots change to various shades of brown in color when old. Although the spots are more often confined to the centre part of the leaf, the whole leaf may be affected. Uniting lesions may involve large areas and in severe infections, the leaves may present a ragged and scorched appearance. Severely affected leaves interfere with the development of the corms.

Accompanying the spots is a copious gummy exudate, which may either dry in small droplets or occur as a thin brittle layer over the leaf. Wind-blown soil, tiny insects and other particles may be found embedded in the exudate.

Young stock is more susceptible than more mature plants. The bacteria overwinter in infected leaves. Wet, warm weather and poorly drained soil favor the spread of the disease.

Control

1. Remove and burn infected leaves.
2. Do not plant corms on ground where disease has been present.
3. Soil should be well drained.
4. Soak the corms in corrosive sublimate 1:1000 (1 tablet in 1 pint of water, or 1 oz. in 6 gals. of water) for 30 minutes.

BACTERIAL BLIGHT OF PELARGONIUM



Fig. No. 47. Bacterial Blight of Pelargonium. 1 — Spots on leaves of house geranium. 2 — Natural infection on leaves of Wild Cranesbill. (After Lewis.)

Cause

Pseudomonas erodii Lewis.

Plants Attacked

Pelargonium (house geranium), Wild Cranesbill.

Symptoms

This is principally a leaf disease, occurring at first as minute, pellucid dots which can be observed by transmitted light. The spots enlarge with age, becoming circular or irregular in shape, $\frac{1}{8}$ to $\frac{1}{4}$ inches in diameter. The centres become reddish brown, sunken, with a colorless border. Many spots on older leaves give rise to extensive diseased areas. The leaves may turn yellow, ragged and shrivelled.

The bacteria remain alive in the soil and in diseased leaves. They attack the leaves through the stomates and the disease spreads rapidly under warm, moist conditions.

Control

1. Pick off and burn all leaves showing infection.
2. Avoid overcrowding in the greenhouse.
3. Regulate the ventilation to reduce humidity.
4. Avoid splashing the leaves from the soil when watering.
5. Do not use soil in which the disease has been present.

BACTERIAL LEAF SPOT OF GERANIUM

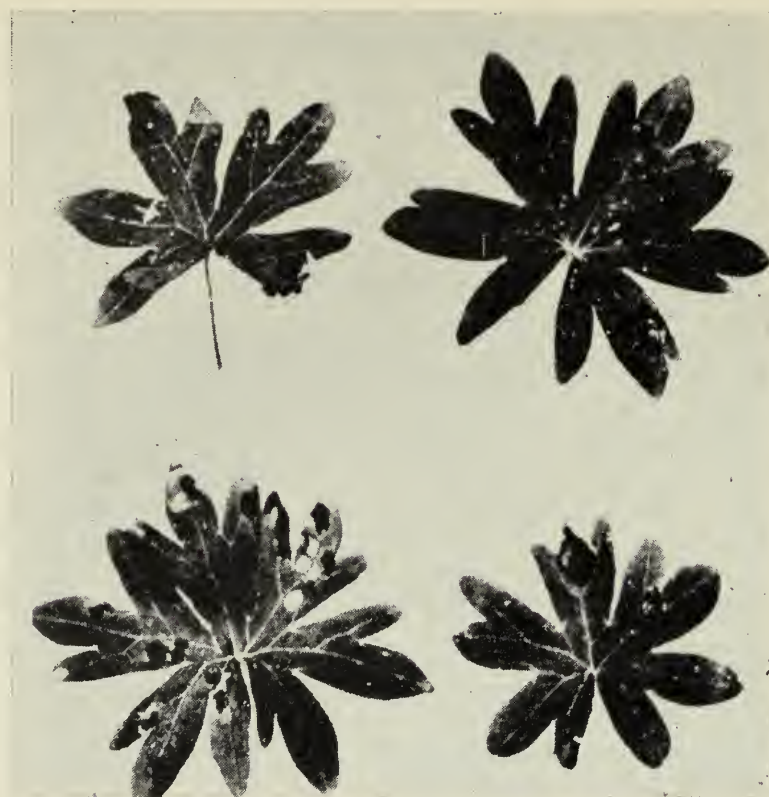


Fig. No. 48. Bacterial Leaf Spot of Geranium. (After Burkholder.)

Cause

Xanthomonas geranii (Burkh.) Dowson.

Plants Attacked

Geranium.

Symptoms

The spots appear mostly on the leaves, but occur occasionally on stems and petioles. They are irregular in outline, and reddish brown on the upper side of the leaf. The spots are confined to the spaces between the veins. Large areas may be involved when numerous spots join together. Several spots on a single lobe of the leaf may cause that portion of the leaf to shrivel, turn brown and die. Many small lesions may cause a general yellowing or reddening of the tissue, and leaves may drop from the plant.

The bacteria overwinter in the lesions on the leaves and gain entrance through stomates and injuries.

Control

1. Pick off and destroy affected leaves.
2. Avoid crowding in the greenhouse.
3. Reduce humidity, and avoid splashing from soil when watering.
4. Do not plant on soil where the disease has been present.

YELLOW DISEASE OF HYACINTH

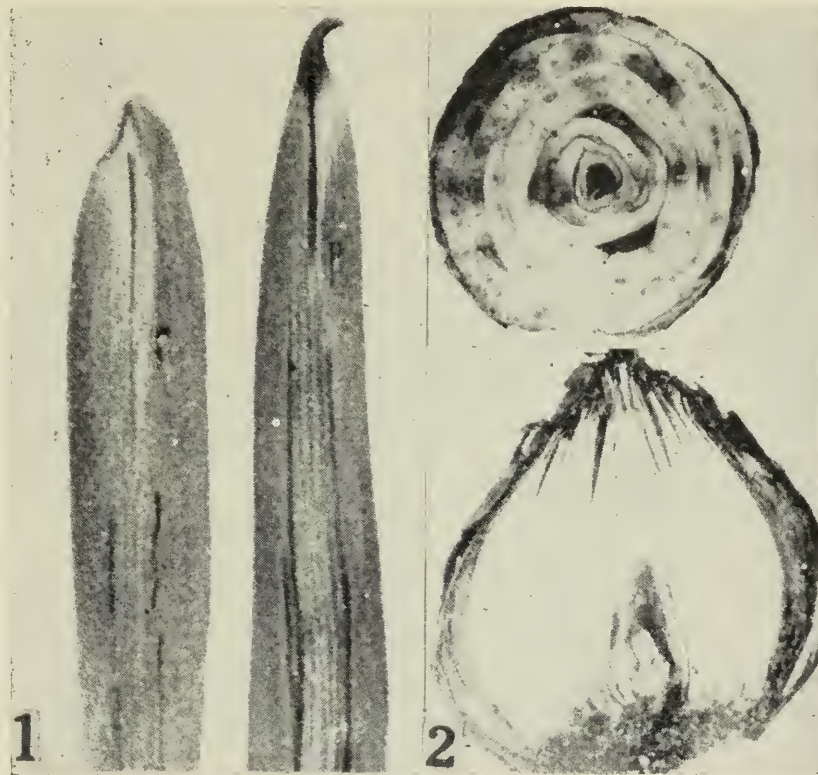


Fig. No. 49. Yellow Disease of Hyacinth. 1 — Infected leaves. 2 — Transverse and longitudinal sections of bulbs, showing extent of rot. (After Erw. Smith and Drayton.)

Cause

Xanthomonas hyacinthi (Wakker) Dowson.

Plants Attacked

Hyacinth.

Symptoms

The disease first appears in the tips of the leaves in the form of water-soaked spots or stripes, found generally in the centre of the leaves. As the stripes spread, the areas turn yellow, and the leaves shrivel and die. Infected flower stalks also may become brown and shrivelled. The disease progresses downwards into the scales in the bulbs. Cavities are formed in the bulbs which are invaded by secondary organisms, causing rapid rot of the bulb. Cross sections of the bulbs, flower stalks and leaves show masses of yellowish slime oozing from the vascular tissues. The disease may spread from a mother bulb to daughter bulbs.

The disease is spread by splashing rain, wind, cultivation and the cutting knife.

Control

1. Plant only disease-free bulbs.
2. Destroy bulbs which show softening, or other signs of the disease.
3. Periodically inspect plants in the field. If an affected plant is found, isolate by covering with jar or pot. Remove and burn isolated diseased plants after harvesting.
4. When cutting or "scooping" bulbs, disinfect cutting knife in corrosive sublimate 1:1000 (1 tablet in 1 pt. of water, or 1 oz. in 6 gals. of water).
5. Avoid too heavy application of fertilizer or other nitrogenous material.

BACTERIAL BLIGHT OF IVY



Fig. No. 50. Bacterial Blight of Ivy. Natural infection on leaves. (After Carpenter.)

Cause

Xanthomonas bederae (Arnaud) Dowson.

Plants Attacked

Various varieties of Ivy.

Symptoms

The disease more commonly affects the leaves but may occur on petioles and stems. Infection appears first on the leaves as small, water-soaked spots, which enlarge to form roughly circular areas with brown to black centres. As the spots mature they become dry and cracked. Under high humidity an orange-red exudate may occur on infected areas. On old foliage the spots may be surrounded by a reddish-purple colored margin. Heavily infected leaves turn yellow and fall.

Lesions on petioles are dark brown to black and may girdle the petiole, causing the attached leaf to fall. On the stems, diseased areas are brown to black, and on older stems definite cankers are produced. These are sunken and cracked, with swollen margins and are responsible for retarding the growth of the plant.

Control

1. Remove and burn infected leaves and discard plants with stem cankers.
2. Avoid excessive humidity and overcrowding in the greenhouse.
3. Treat sand, cinders, benches etc., on which infected plants have stood with corrosive sublimate 1:1000 (1 tablet in 1 pint of water, or 1 oz. in 6 gals. of water).
4. Change or sterilize the soil.
5. Avoid splashing the leaves when watering.

BACTERIAL BLIGHT OF IRIS



Fig. No. 51. Bacterial Blight of Iris. (After Burkholder.)

Cause

Bacterium tardicrescens McCulloch.

Plants Attacked

Iris.

Symptoms

The disease appears first as small, pale lesions on the leaves. These enlarge longitudinally to become irregular in shape and greyish brown in color. Occasionally the lesions appear as elongated streaks on the edges of the leaf. Under moist conditions an exudate is apparent over the lesions and dries as a fine scale. The lesions are more prevalent on the middle and upper parts of the leaves. Severe infection will cause the leaves to become yellow, shrivel and die. The rhizomes show no trace of infection.

The disease is favored by warm, damp weather and therefore is more common in midsummer. The bacteria gain entrance through wounds. They overwinter in the soil and infected leaves.

Control

1. Remove old and diseased leaves in the fall and burn.
2. Do not grow iris plants on infected ground.

BACTERIAL BLIGHT OF POPPY



Fig. No. 52. Bacterial Blight of Poppy. Shirley poppy showing isolated leafspots.
(After Bryan and McWhorter.)

Cause

Xanthomonas papavericola (Bryan and McWhorter) Dowson.

Plants Attacked

Shirley and Oriental Poppy.

Symptoms

The disease occurs on leaves, stems, floral parts and pods. Young lesions appear as minute, water soaked spots on the leaves, and enlarge to form black, circular areas surrounded by a water soaked ring. Considerable bacterial exudate may be present. Tissue between the spots turns yellow and in severe infections, defoliation may result.

The spots on the stems are intensely black and are longitudinal in shape. When close together they may girdle the stem. Young sepals are particularly susceptible and they may be entirely blackened. When the petals are attacked the development of the flower is stopped. The spots on the pods are black and prominent. The bacteria gain entrance through stomates and water pores. The disease spreads rapidly and when severe may kill the plants.

Control

1. Infected plants should be destroyed.
2. Do not plant poppies on the same ground for 3 years.
3. Use seed from healthy plants.

BACTERIAL BLIGHT OF STOCK

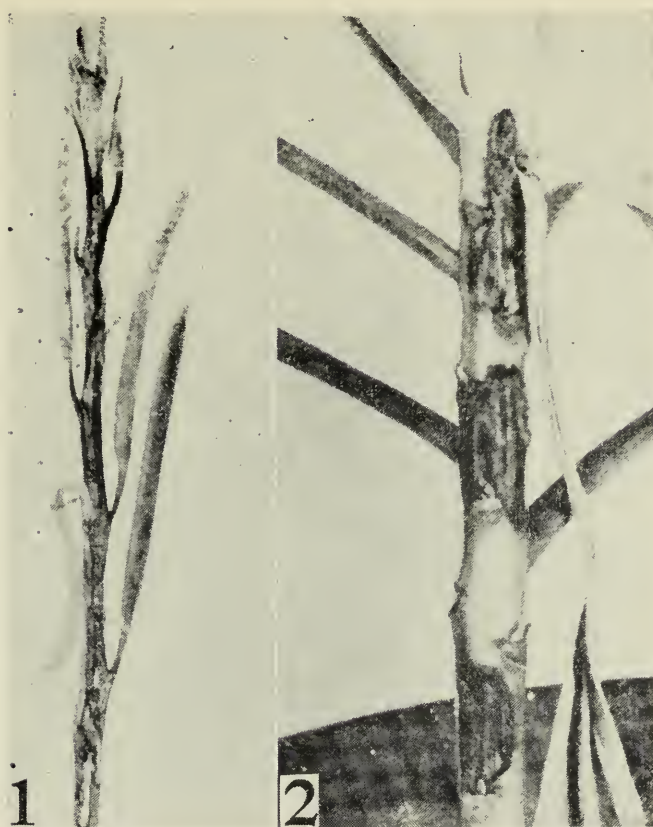


Fig. No. 53. Bacterial Blight of Stock. 1 — Lesions on a lateral branch. 2 — Lesions on main stem.
(After Kendrick and Baker.)

Cause

Xanthomonas incanae (Kendrick and Baker) Starr and Weiss.

Plants Attacked

Stock.

Symptoms

The disease affects the main stem and branches in all stages of the plant's development. Young plants wilt and collapse when they are 2 to 4 inches high. The stem is soft, water-soaked and yellowish. In older surviving plants the disease does not progress so rapidly. Lower leaves become yellow and drop off. Stem and branches show dark brown, sunken lesions from which a yellowish exudate may appear. Stems may crack open and be so weakened that they may break off at ground level. Girdling or wilting may kill the plants or cause stunting.

The bacteria are carried in the soil and on the seed. They gain entrance into the vascular system, destroying the conducting vessels and pith.

Control

1. Treat seed by enclosing in a cheesecloth bag and immersing in water maintained at a temperature of 53°-55°C. (127°-131°F.) for 10 minutes. They then should be plunged in cold water and dried.
2. Sterilize soil or practise a 3 year rotation.
3. Avoid crowding of seedlings in greenhouse.

BACTERIAL STREAK DISEASE OF SWEET PEA



Fig. No. 54. Bacterial Streak Disease. Affected leaves and stem of broad bean.
(After Paine and Lacey.)

Cause

Erwinia lathryi (Manns and Taub.) Holland.

Plants Attacked

Sweet pea, garden pea, bean, soybean, broadbean and red clover.

Symptoms

This disease generally makes its appearance on mature plants at the flowering stage. Purplish brown streaks appear on the stems, beginning at the base and extending upwards. Streaks also may be found on petioles, flowers, flower-stalks and pods. Small, round water soaked spots appear on the leaves, running together until the whole leaf may be affected. The leaves turn dark brown, shrivel and die. Lower leaves fall prematurely and when the disease is severe the whole plant may be destroyed.

The bacteria may be carried over on the seed as well as on diseased plants.

Control

1. Gather and burn infected plants after the flowering season.
2. Choose seed from disease-free pods.
3. Treat the seed by soaking in alcohol for 1 minute, followed by immersing in corrosive sublimate 1:1000 (1 tablet in 1 pint of water, or 1 oz. in 6 gals. of water) for 20 minutes.

FASCIATION OF SWEET PEA



Fig. No. 55. Fasciation of Sweet Pea. Caused by *Agrobacterium tumefaciens* (Smith and Townsend) Conn. (After Garrard.)

Cause

Known to be caused by *Corynebacterium fasciens* (Tilford) Dowson, or *Agrobacterium tumefaciens* (Smith and Townsend) Conn, but may occur independently of these organisms.

Plants Attacked

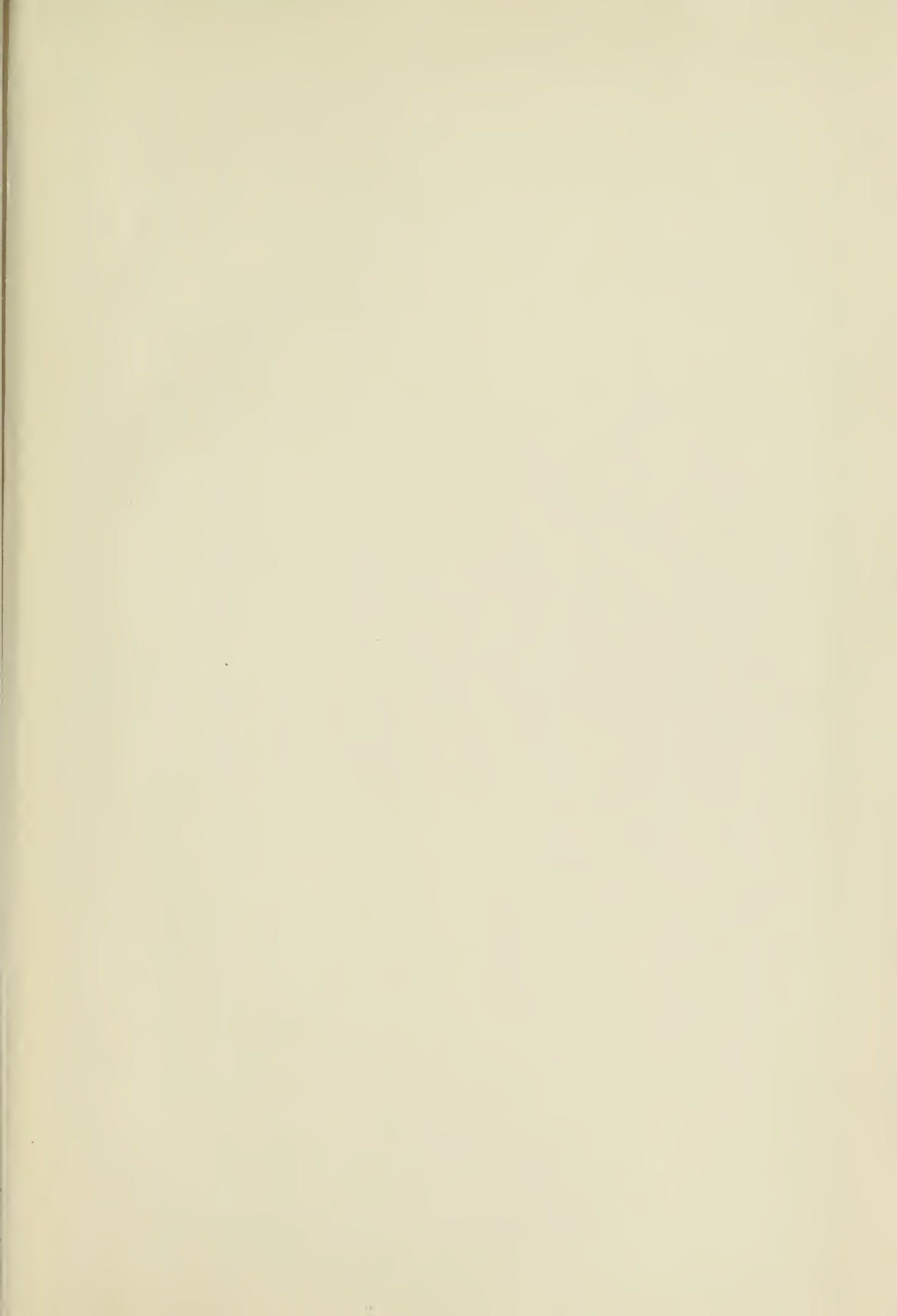
May occur on a variety of plants, including sweet pea, chrysanthemum, geranium, carnation, petunia etc.

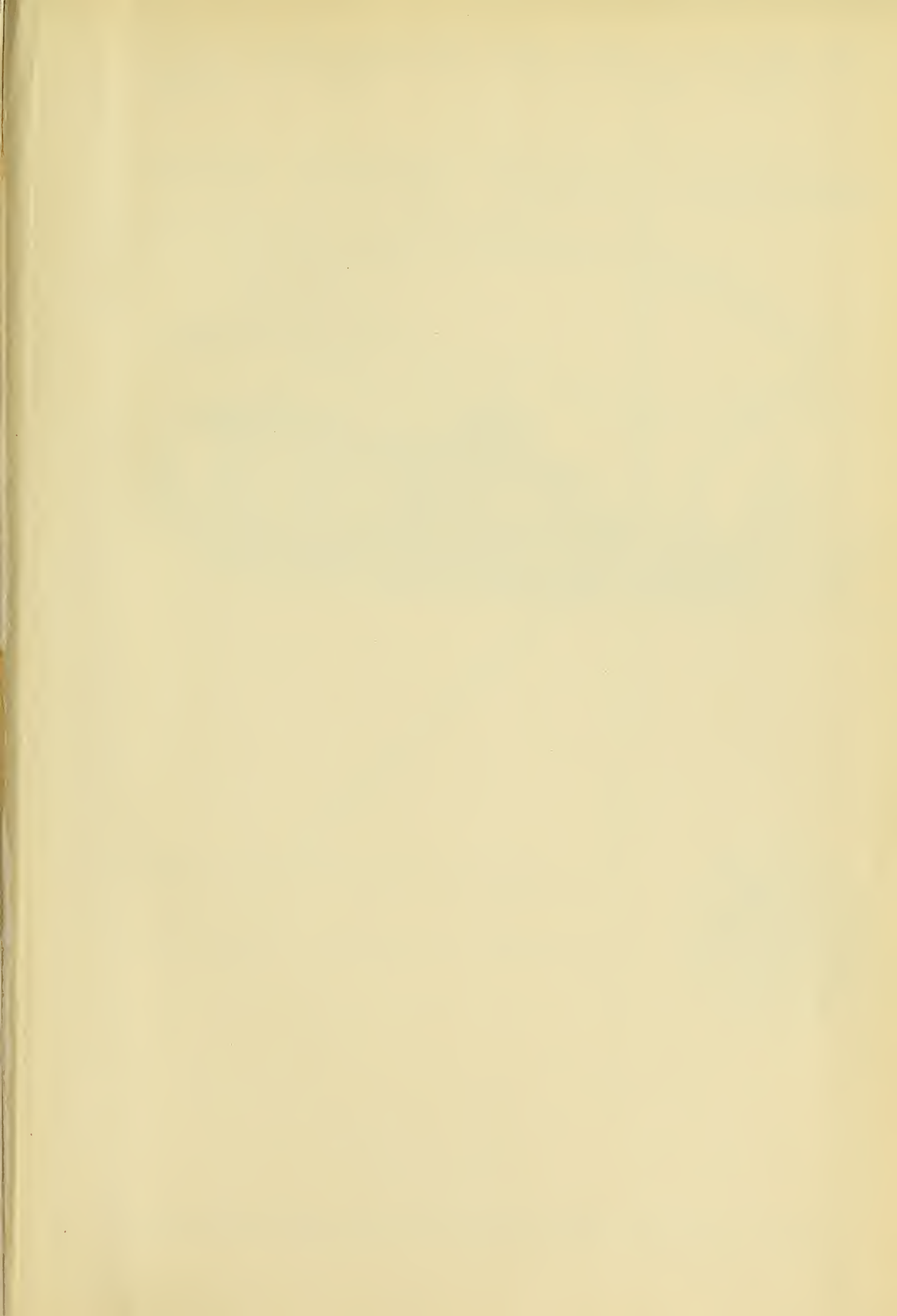
Symptoms

The disease usually occurs before flowering and may manifest itself as abnormal growths or malformations at the base of the stem just above or below ground level. Numerous short, fleshy wide stems with distorted and misshapen leaves may be produced. The base of the stem may be grossly enlarged with stubby roots and stems. Normally, while the upper part of the stem may be somewhat dwarfed, the plant is not seriously affected, but if fasciation is severe, the plant may be severely stunted and flowers may be absent. The bacteria may be found on the seed or in the soil.

Control

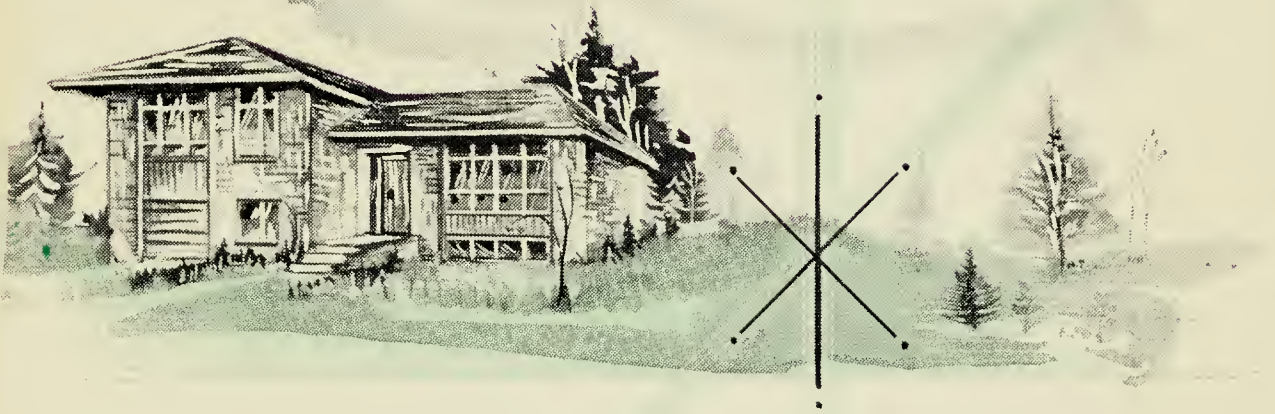
1. Sterilize or replace greenhouse soil.
2. Sterilize seed by dipping in alcohol for one minute and then immersing in corrosive sublimate 1:1000 (1 tablet in 1 pint or 1 oz. in 6 gals. water) for 20 minutes.





Jan/66 replacing Bul #71 "Rural Sewage Disposal"

MALL SEPTIC TANK SYSTEMS



ONTARIO DEPARTMENT OF HEALTH
environmental sanitation division



Published by the Authority of Honourable M. B. Dymond, M.D., Minister of Health

This bulletin has been approved by the Department of Engineering Science of the Ontario Agricultural College, Guelph, to replace their former bulletin 471 on Rural Sewage Disposal. Their suggestions in this connection are gratefully acknowledged.

Acknowledgement is also due to the United States Department of Health, Education and Welfare, Public Health Service, on whose considerable field research many of the design criteria of this bulletin are based.

FOREWORD

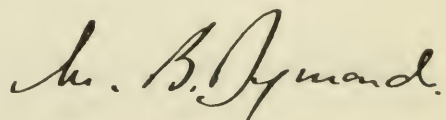
This bulletin has been prepared for the use of persons intending to construct homes in unsewered areas. It will be equally useful to anyone planning to change an existing septic tank system.

Despite the widespread extension of municipal sewerage systems in Ontario to meet the demands of new areas for municipal services, there were 12,500 new building lots created by registered plans of subdivision in 1958 which were not served by sewers. Many of the owners of these lots will install pressure water systems, or have available municipal water supply, and will want the modern convenience of water closets connected to a septic tank system.

When properly designed and installed under suitable conditions, as recommended by the Medical Officer of Health, a septic tank and tile bed system should not endanger any water supply nor should it cause nuisance from odours or surface ponding. Maintenance will be kept to a minimum by good design and construction.

Anyone planning to build a home in an unsewered area is urged to consult the Medical Officer of Health before making any final plans or commencing construction. The Medical Officer of Health and his staff have expert knowledge of local septic tank problems gained through experience and will be able to give valuable advice. The Public Health Act requires that the approval of the Medical Officer of Health must be given in writing before a system is established, and it is therefore wise to make plans in accordance with his wishes. Wide variations in soil conditions throughout the province may make it necessary for the Medical Officer of Health to modify some of the details given in this bulletin in order to meet local conditions.

It is the hope of the Provincial Department of Health that this bulletin will serve as a useful guide to satisfactory and economical sewage disposal which is essential to a healthful environment.

A handwritten signature in dark ink, appearing to read "Mr. B. Dymond". The signature is fluid and cursive, with a large initial "M" and "D".

Minister of Health.

January 29, 1960.

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*) Attention is also drawn to the construction details shown on Plans A259-8098 and A259-8039 ,published by the Ontario Department of Agriculture in their "Canadian Farm Building Plan Service".

PART I

SMALL SEPTIC TANK SYSTEMS

1. How to use this bulletin

The first part of this bulletin outlines the legal requirements and the public health aspects involved in the use of septic tank systems, describes how such systems work and gives essential guidance about the location of any installation for the suburban and country resident. The drawings and tables given in this part of the bulletin enable the septic tank size to be selected according to the number of people it is required to serve, and tell how to determine how much field tile will be required.

The second part of the bulletin includes some additional material which enables a system to be designed or checked for any small community, including individual households, schools, motels, small hospitals, or other institutions. Septic tank systems for anything bigger than the single domestic dwelling should be designed by a professional architect or engineer, and if there are any special circumstances, such as difficult ground conditions, an architect or engineer should be called in to advise even on the installation for an individual dwelling.

2. The public health aspect

People who live in the larger towns seldom have to give a second thought to the disposal of the sanitary wastes from their homes. Public sewerage systems and sewage disposal plants operated and maintained by the municipality remove and dispose of such wastes. The householder in an unsewered area, however, must himself provide for the disposal of his domestic sewage. This is usually done by means of a septic tank and sub-soil absorption system close to his residence. A correctly designed and constructed system of this sort will work effectively and safely, but a system which is badly designed and located, or badly constructed, can lead to considerable nuisance and expense, and can seriously endanger the health of others. In particular, his installation must be so planned and built that water supplies do not become polluted and that sewage does not pond on the ground surface with consequent hazard from fly-borne diseases or direct contact. If these failings are not avoided, diseases such as typhoid fever, paratyphoid fever, dysentery and some of the virus diseases can be transmitted and spread.

3. The law relating to household sewage disposal

The approval of the Medical Officer of Health for any septic tank installation is required under the Public Health Act in all areas with

municipal organization. Some municipalities also have by-laws setting out the local requirements in more detail.

The name of the Medical Officer of Health and his Sanitary Inspector can be obtained from the Municipal Clerk's Office. In unorganized territory (that is, a community which has no municipal organization), householders will find it advantageous to seek information from the Department's Provincial Sanitary Inspector for the district concerned. These local health officials can give valuable information to householders installing septic tank systems, since they will usually have detailed local knowledge which might affect the proposals as well as their technical knowledge of the basic requirements.

Alternatively, information can be obtained directly from the Division of Environmental Sanitation, Department of Health for Ontario, 67 College Street, Toronto 2B.

4. What a septic tank system is

The purpose of a septic tank system is to return to the soil the sewage and other liquid wastes from the household in such a manner that water supplies do not become polluted and no sewage appears at the ground surface. It consists essentially of two parts:

- The septic tank which prepares the liquid for application to the soil.
- The field tile bed which distributes the liquid to the soil.

The purpose of the septic tank is frequently misunderstood. No purification takes place in the septic tank; the liquid effluent from the tank is just as highly polluted as the wastes which entered it. Its only purpose is to remove from the waste solids which could not be absorbed by the soil in the field tile bed. Sufficient capacity is provided in the tank for insoluble solids to fall to the bottom; and in addition, bacteriological action breaks down much of the solid matter to liquids and gases. Thus only liquid matter overflows from the tank and passes on to the field tile disposal bed, and being liquid it can be absorbed by the soil surrounding the field tiles.

The second part of the system, the tile disposal bed, consists of pipes laid with open joints in trenches so that the liquid wastes can escape at the joints and be absorbed by the surrounding soil. Having reached the soil, further bacteriological action takes place, and at this stage some measure of purification is effected. The field is designed, however, so that no polluted liquid escapes from it to the ground water table which might be feeding wells in the vicinity, or to watercourses which may later be used for water supplies.

It will be seen that the design of a septic tank system depends mainly on two factors:

- The quantity of waste to be disposed.
- The ability of the soil to absorb the liquefied waste.

The wastes to be treated in the septic tank system are sewage from toilets, waste waters from the kitchen, and the waste from baths, wash-basins, showers, sinks and washing machines. In some areas where the use of garbage grinders is permitted, the waste from these units will also go to the septic tank system. Surface waters from roofs, yards and foundation drains should be prevented from entering the septic tank system.

The suitability of the soil for absorbing the liquid waste is determined by a soil percolation test. Sandy soils will, of course, absorb more liquid than soils containing more clay. Consequently, it depends largely on the clay content of the soil what length of field tile must be laid to dispose of the wastes.

The materials of construction for septic tanks are often governed by local regulations. Domestic septic tanks are usually built of concrete or coated metal. Concrete has a much longer life than coated metal. The essential, however, is that the septic tank must be completely watertight. In shape, the tank should be either rectangular or a horizontal cylinder. The former shape is preferable for a concrete tank and the latter for a coated metal tank.

If a rectangular tank is used, best results are obtained if the length is between two and three times the width. Some improvement in operation is obtained if the tank is divided into two portions. In this case the first portion of the tank should be about twice the capacity of the second portion. The depth of the liquid (that is from the bottom of the tank to the level of the overflow) should be 4 feet to 4 feet 6 inches. An additional foot of depth above the water surface is required for ventilation purposes and for floating scum storage.

A septic tank should preferably be fitted with a siphon which automatically discharges the correct volume of sewage to the whole disposal bed and prevents "dribble flows" which use only a portion of the bed. A siphon has the further advantage that it assists in preventing the system from freezing up in extremely cold weather.

A 3 inch diameter siphon is adequate for any domestic septic tank. This is obtainable through any plumber, who should be consulted about the depth of water required in the siphon chamber to operate the particular make of siphon he will supply.

5. Locating a septic tank system

A septic tank should not be closer than:

- 50 feet to any well or other source of domestic water supply.
- 5 feet to any building.
- 10 feet to any property boundary.

The disposal bed should not be closer than:

- 100 feet to the nearest well or other source of domestic water supply.
- 50 feet to a drilled well which has a casing to 25 feet below ground.
- 25 feet to a building.
- 10 feet to a property boundary.

This is illustrated on Drawing No. 1, page 8.

The ideal location for a tile disposal bed is in well-drained sandy soil remote from any wells or other drinking-water sources. Few householders will be fortunate enough to have these ideal conditions, but for the percolation bed to work satisfactorily the following conditions should exist:

- The maximum elevation of the ground water table should not be less than 4 feet below the ground surface.
- Any rock formation or other impervious stratum should be more than 4 feet below the bottom of the disposal bed trenches.

The required length of tile trench should be determined by percolation tests.

6. The soil seepage or percolation test

(a) At least 4 separate tests (which can run concurrently) should be carried out at points selected over the whole of the proposed tile bed site.

(b) Dig a hole about 1 ft. square to the depth at which it is proposed to lay the drain tile. Alternatively, this hole could be bored with a 4-inch earth auger.

(c) Remove all loose material from the hole and add two inches of coarse sand or fine gravel to protect the bottom from scour and sediment.

(d) Fill the test hole with clear water to a minimum depth of 12 inches over the gravel. Keep this supply replenished until the water seeps away at a constant rate. The test holes should be kept filled with water for at least 4 hours or preferably overnight for this purpose. The

purpose of this is to make sure that the soil is thoroughly waterlogged when the test is carried out. A false impression of the capacity of the soil to receive sewage will be obtained if it is dry when the test is carried out.

(e) Wait until the soil has become saturated so that the rate of drop of the water level is constant and then find the time required for the water to drop 1 inch. This is the standard percolation time “t”, referred to in the table which follows and in the charts in the second part of the bulletin. The measurement of “t” is most easily carried out by using a measured stick graduated in inches which is placed vertically in the hole, its end just touching the water surface. If another board or straight edge is placed across the top of the hole, the time for a 1 inch drop in the water surface can easily be measured by observing the graduation on the vertical stick.

Time “t” in minutes for water to fall 1”	No. of feet of 18” wide trench per person (Domestic residences only)		
1	10	(But not less than 150’ total)	
5	22	“	“
10	32	“	“
20	45	“	“
30	55	“	“
40	63	“	“
50	70	“	“
60	77	“	“
over 60	Not suitable for subsurface absorption		

N.B. *This table is for domestic systems only. It does NOT apply to schools, motels, hospitals or other such communities. The chart in Part II of the bulletin should be used for these.*
The length of the trench may be decreased for households without washing machines, and must be increased for households with garbage grinders. The increase or decrease can be determined from the chart in Part II.

In using the above table, allow for the maximum number of people likely to reside in the dwelling (even temporarily) at one time. Allow for at least two persons per bedroom.

7. Planning a septic tank system

Steps in planning a system are:

- (a) Select the site for the tank and the tile bed (see section 5 and drawing No. 1, page 8).

- (b) Choose a tank size from the table on page 10. Note that no septic tank should be less than 500 gallons capacity.
- (c) Carry out the soil seepage test (see section 6).
- (d) Calculate the length of tile trench required according to the number of persons (No tile field should have less than 150 feet of 18 inch wide trench and tile).
- (e) Submit your plan to the Medical Officer of Health for his approval.

8. Operation and maintenance of septic tank systems

Provided the design and construction of the septic tank system have been properly carried out no operating difficulties should be experienced. People are often uncertain whether some types of waste may be discharged safely to the septic tank system. They are also frequently uncertain whether a grease trap is necessary. For normal domestic systems which Part I of this bulletin is intended to cover, the amount of grease coming from the kitchen would be insufficient to warrant the construction of a separate grease trap. Similarly, detergents, lye, or other household cleansers in the quantities normally used would not hinder the bacterial action in the septic tank. Care should be taken, however, that excessive quantities of these materials do not enter the system. Where water conditioners or softeners are used, the waste from the re-charging cycle should be kept out of the septic tank system.

Various preparations are on the market which are said to start, accelerate or help the action in the septic tank. Apart from these proprietary products it is often suggested that yeast would help the action. There appears to be no necessity for the addition of any such product to start or assist the action of the septic tank. All bacteria necessary for the operation are already contained in the sewage entering the system.

Trouble is sometimes experienced with septic tank systems after large house parties have been held. During such periods abnormal quantities of liquid reach the system, which results in overloading. Similarly, field tile disposal beds sometimes become overloaded if excessive watering is carried out in the garden in the vicinity of the bed.

With proper construction and operation very little maintenance of septic tank disposal systems should be necessary. With the tank capacities previously given, it should not be necessary to clean the tanks more than once every three years. They should, however, be inspected at least once a year and cleaned when necessary. Neglect in cleaning out a septic tank when required may cause sludge or scum to be carried

out from the tank, which may clog the tile disposal field. In this case not only does the tank have to be cleaned but the disposal field may also have to be reconstructed.

Inspection of the sludge and scum accumulation is the only way to determine when a tank requires to be cleaned. This is indicated if either:

- (a) the bottom of the scum mat is within approximately 3 inches of the bottom of the outlet pipe, or
- (b) the surface of the sludge accumulation comes within 18 inches below the outlet device.

In most localities there are private contractors who will clean out septic tanks. Tanks should not be washed or disinfected after pumping. A small residual of sludge should be left in the tank for seeding purposes. The means and place of disposal of the contents of the tank should be approved by the local health authority.

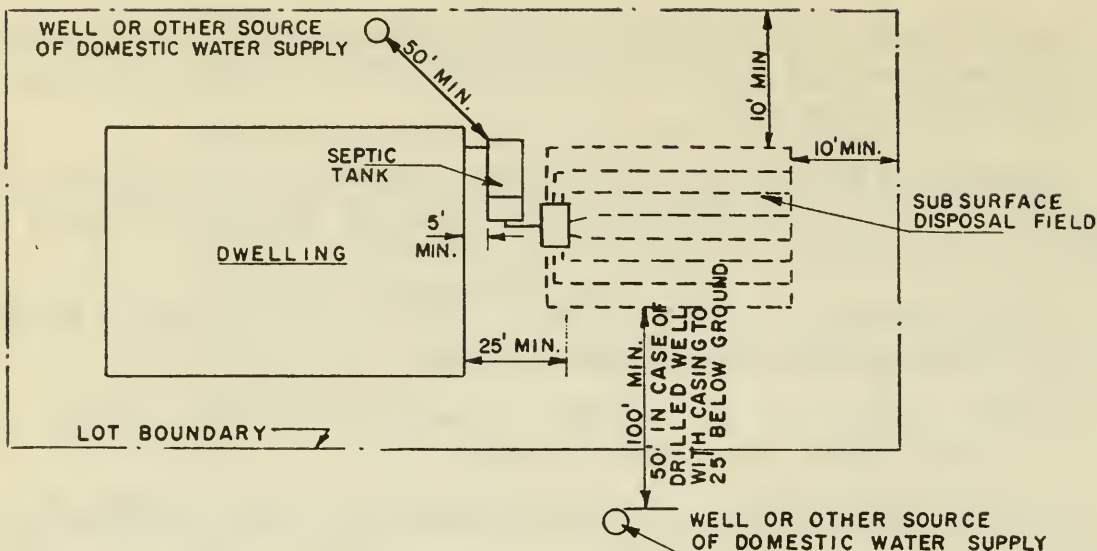
Summer cottage owners should have their septic tanks pumped out to within 6" of the bottom at the end of the season's usage. The entire drainage system, water storage system and all traps and fittings should be emptied. Traps may be refilled with kerosene or anti-freeze over the winter to prevent the entry of rodents.

The successful operation of tile disposal beds is often upset by damage caused by vehicular traffic, blocking by root growth, and freezing during severe weather at the upper ends of the tile runs.

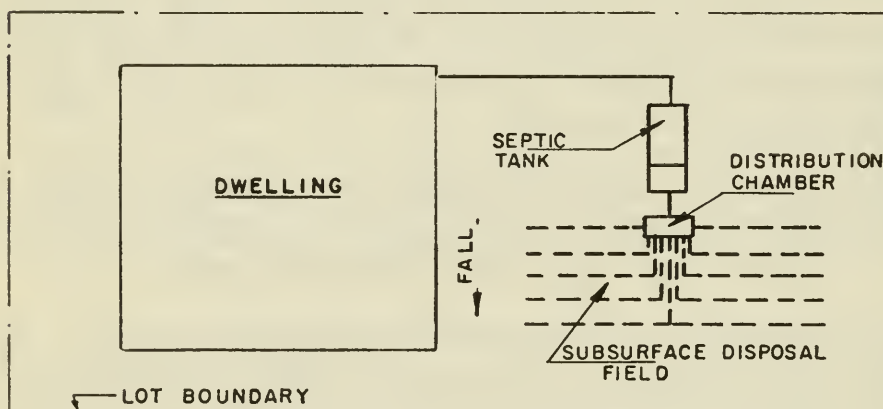
No wheeled or tracked vehicle should be allowed over the tiles once they are laid, either during or after construction. If necessary, the tile area should be fenced off if visitors who do not know of the location of the tile field are liable to run over it unknowingly.

It is much easier to prevent root trouble than to cure it. Provided no bushes or large plants and nothing other than grass is grown over the tile field, there should be no trouble from roots. Systems heavily blocked by roots may have to be cleared by a plumber who has the proper tools for the purpose.

Frost will not interfere with field tiles laid at the depths recommended in this bulletin, if siphons are used to distribute the sewage. If no siphon is installed, the small flow dribbling through may freeze, but the larger flush discharged by a siphon remains warm long enough for the sewage to disperse into the ground surrounding the tiles.



TYPICAL LAYOUT OF SEPTIC TANK AND SUBSURFACE DISPOSAL FIELD
(GROUND FAIRLY LEVEL)

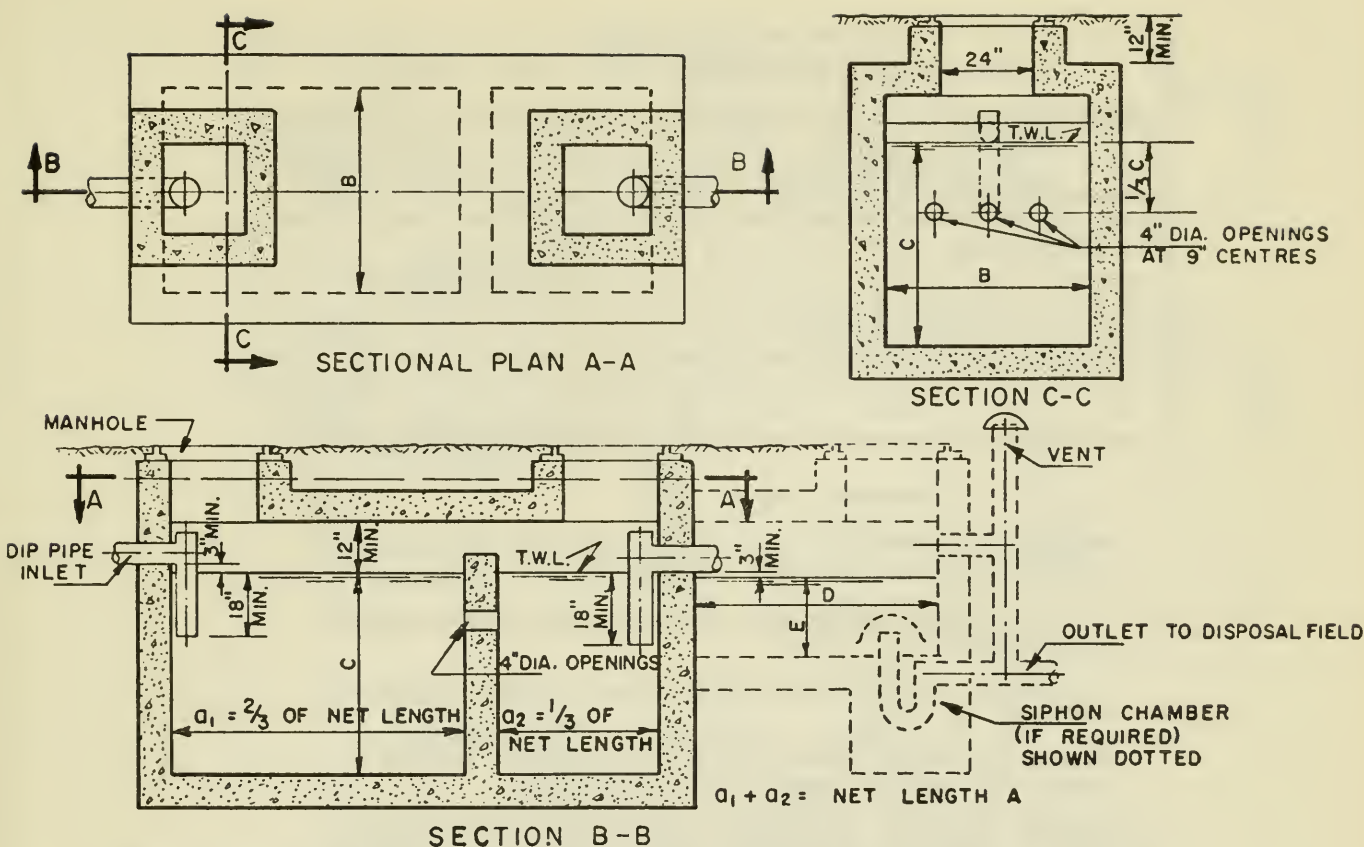


TYPICAL LAYOUT OF SEPTIC TANK AND SUBSURFACE DISPOSAL FIELD
(SLOPING GROUND)

NOTES:

1. THE ABOVE LAYOUTS ARE SUITABLE FOR WELL DRAINED SOIL AS DETERMINED BY PERCOLATION TESTS. FOR OTHER SOILS, ALTERNATIVE METHODS OF DISPOSAL OF THE SEPTIC TANK EFFLUENT MAY BE NECESSARY.
2. LOCATION OF TANK AND DISPOSAL FIELD TO BE ON LOWER GROUND THAN ADJACENT WELLS ETC. IF POSSIBLE.
3. INTERNAL PLUMBING AND MAIN DRAINAGE OUTLET SHOULD BE DESIGNED WITH A VIEW TO CONNECTING TO POSSIBLE FUTURE SANITARY SEWERS.
4. ROOF WATER, SURFACE WATER, DISCHARGE FROM FOOTING DRAINS ETC. TO BE EXCLUDED FROM ENTRY TO SEPTIC TANK.
5. SUBSURFACE DISPOSAL FIELDS NOT TO BE LOCATED IN SWAMPY GROUND OR IN GROUND LIABLE TO FLOODING.
6. INSPECT TANKS ANNUALLY. CLEAN THE TANK WHEN COMBINED DEPTH OF SLUDGE AND SCUM LAYERS IS $\frac{1}{3}$ THE DEPTH C (SEE DRAWING 2)
7. METHOD OF SLUDGE DISPOSAL TO BE APPROVED BY THE M.O.H.

HOUSEHOLD SEPTIC TANK SYSTEMS
GENERAL LAYOUT
NOT TO SCALE
DEPARTMENT OF HEALTH FOR ONTARIO
DIVISION OF ENVIRONMENTAL SANITATION
1959



NOTES:

1. PERFORMANCE OF TANKS IS USUALLY IMPROVED IF DIVIDED INTO TWO COMPARTMENTS AS SHOWN. TOTAL CAPACITY REMAINS THE SAME AS FOR A SINGLE COMPARTMENT TANK.
2. MANHOLE ACCESS SHOULD BE PROVIDED TO EACH COMPARTMENT.
3. SIMPLE SUB-DIVISION MAY BE ATTAINED BY STOP-PLANKS FITTED IN GROOVES BUILT IN SIDE WALLS BUT N.B.! PROVISION TO BE MADE FOR FLOW-THROUGH OF LIQUID (OPENINGS AT APPROX. $\frac{1}{3}$ OF WATER DEPTH, OR BY DIP-PIPES) AND AMPLE VENTILATION SPACE ALLOWED ABOVE T.W.L. (TOP WATER LEVEL) BETWEEN COMPARTMENTS.
4. BAFFLES MAY BE USED AT INLET AND OUTLET OF TANK INSTEAD OF DIP-PIPES. THESE SHOULD EXTEND THE FULL WIDTH OF THE TANK, TOP EDGE NOT LESS THAN 6" ABOVE T.W.L. AND BOTTOM EDGE NOT LESS THAN 18" BELOW T.W.L. SEE ALTERNATIVE DETAILS.
5. INLET PIPE MAY ENTER SIDE WALL OF TANK IF CONVENIENT, BUT CENTRE-LINE OF PIPE MUST NOT BE MORE THAN 6" FROM INLET END WALL.
6. THE SLOPE OF THE INLET PIPE SHOULD BE SUCH THAT INLET VELOCITY DOES NOT EXCEED 3 FEET PER SECOND (1" IN 6 FT. FOR 4" DIA. PIPE: 1" IN 12 FT. FOR 6" DIA. PIPE).
7. PROVISION SHOULD BE MADE FOR NOT LESS THAN 12" OF COVER TO TANK (THIS MAY BE RAISED ABOVE GENERAL GROUND LEVEL WHEN AVAILABLE FALL TO DISTRIBUTION SYSTEM IS LIMITED).
8. A SIPHON CHAMBER (SEE 'GHOST' LINES IN SECTION B-B) SHOULD BE INCLUDED WHERE 500 FEET OF TILE TRENCH OR OVER ARE REQUIRED. THIS CHAMBER SHOULD CONTAIN ENOUGH SEWAGE TO FILL THE TILES $\frac{2}{3}$ TO $\frac{3}{4}$ FULL. A CHAMBER OF 20-25 % OF TOTAL TANK CAPACITY WILL NORMALLY MEET THIS REQUIREMENT.
9. DIMENSION E GIVEN AS GUIDE ONLY. SEE ALSO MANUFACTURER'S REQUIREMENTS.
10. ADD 12" TO DIMENSION C FOR TOTAL INTERNAL DEPTH.
11. FOR DIMENSIONS A, B, C, D AND E SEE DRAWING No. 3.

ATTENTION IS ALSO DRAWN TO THE CONSTRUCTION DETAILS SHOWN ON PLAN No. A158-8039 PUBLISHED BY ONTARIO DEPT. OF AGRICULTURE IN THEIR "CANADIAN FARM BUILDING PLAN SERVICE".

HOUSEHOLD SEPTIC TANK SYSTEMS

CONSTRUCTION DETAILS

NOT TO SCALE

DEPARTMENT OF HEALTH FOR ONTARIO
DIVISION OF ENVIRONMENTAL SANITATION
1959

RECOMMENDED DIMENSIONS OF SEPTIC TANKS							
NUMBER OF BEDROOMS	MAXIMUM NUMBER OF PERSONS SERVED	SETTLING COMPARTMENTS (COMBINED CAPACITY)			CAPACITY (IMPERIAL GALLONS)	SIPHON CHAMBER (IF REQUIRED)	
		LENGTH A	WIDTH B	WATER DEPTH C		LENGTH D	WATER DEPTH E
2 OR LESS	* 5 OR LESS	6'-9"	3'-0"	4'-0"	* 500	4'-6"	1'-6"
3	6	8'-0"	3'-0"	4'-0"	600	5'-6"	1'-6"
4	8	9'-0"	3'-3"	4'-0"	720	6'-0"	1'-6"
5	10	9'-0"	3'-6"	4'-6"	900	6'-6"	1'-6"

* MINIMUM SIZE OF TANK

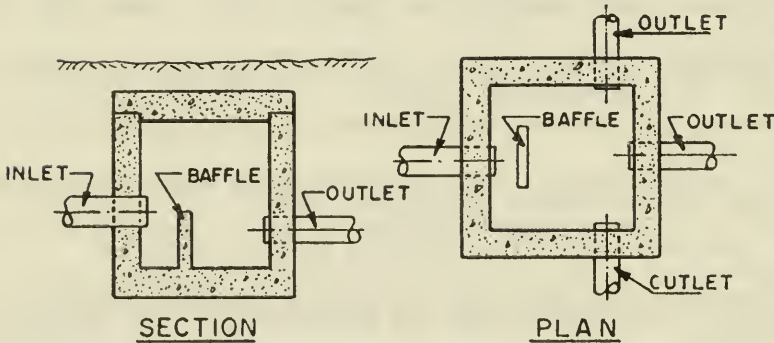
THE ABOVE DIMENSIONS ARE CALCULATED FOR HOUSEHOLDS HAVING AUTOMATIC WASHERS BUT NO GARBAGE GRINDERS.

IF NO AUTOMATIC WASHERS ARE USED, TANK CAPACITY MAY BE DECREASED BY 20%.

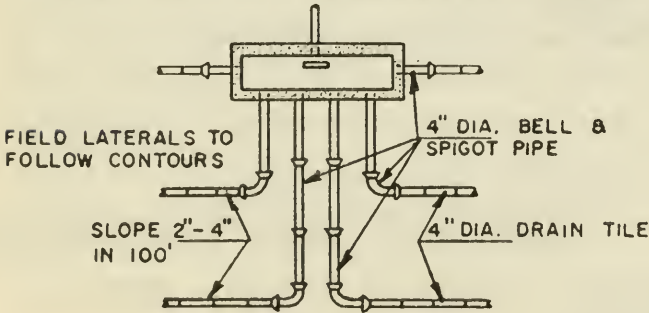
IF GARBAGE GRINDERS ARE USED, TANK CAPACITY SHOULD BE INCREASED BY 20%.

PROBABLE FUTURE USAGE OF THESE MACHINES SHOULD BE TAKEN INTO ACCOUNT WHEN TANK IS DESIGNED.

SIPHON CHAMBER DIMENSIONS GIVEN ARE APPROXIMATE, BUT ARE SUITABLE IN NORMAL CIRCUMSTANCES. THE WATER DEPTH E, HOWEVER, DEPENDS ON THE SIPHON USED: CONSULT THE SUPPLIER. THE VOLUME OF SEWAGE HELD SHOULD BE $\frac{2}{3}$ TO $\frac{3}{4}$ OF THE VOLUME OF THE TILES IN THE DISPOSAL FIELD. THE VOLUME OF 100 FT. OF 4" DIA. TILE IS 55 GALLONS, OR $\frac{8}{34}$ CUBIC FT. THUS ALLOW 40 GALLONS PER 100 FT. OF TILE.

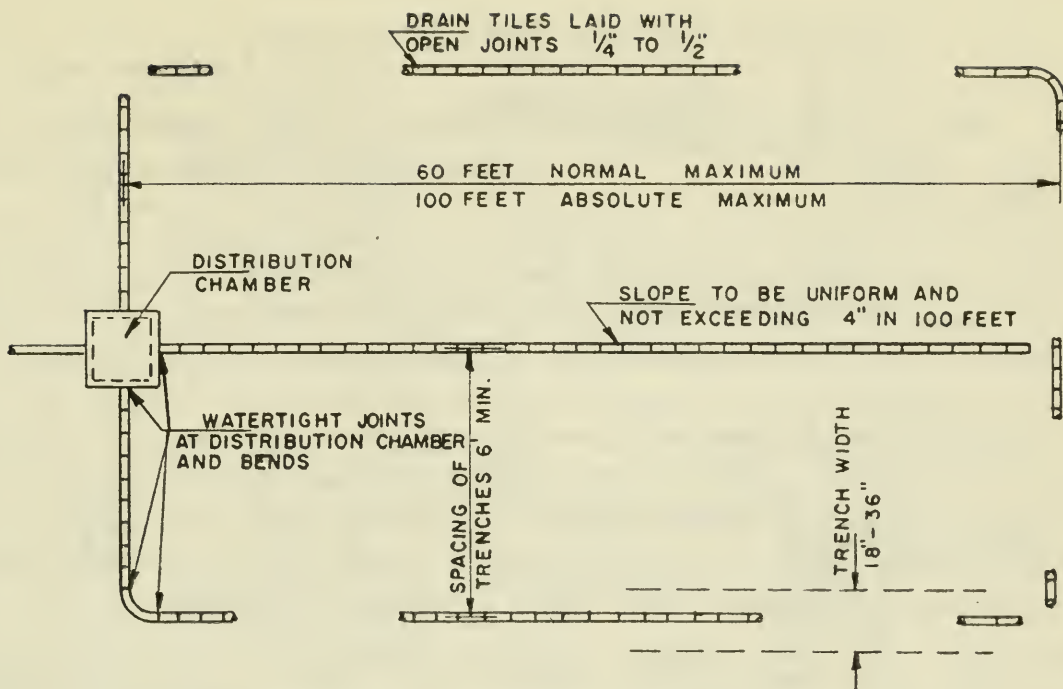


DISTRIBUTION CHAMBER FOR FAIRLY LEVEL GROUND

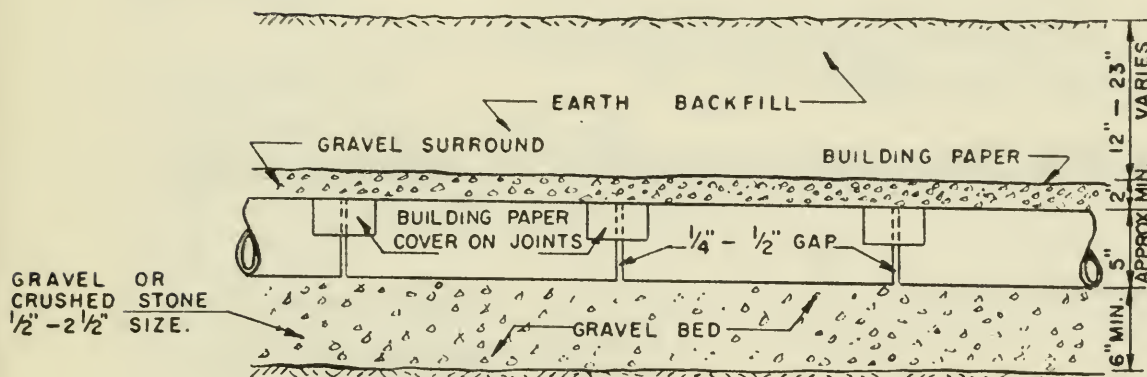


DISTRIBUTION CHAMBER FOR SLOPING GROUND

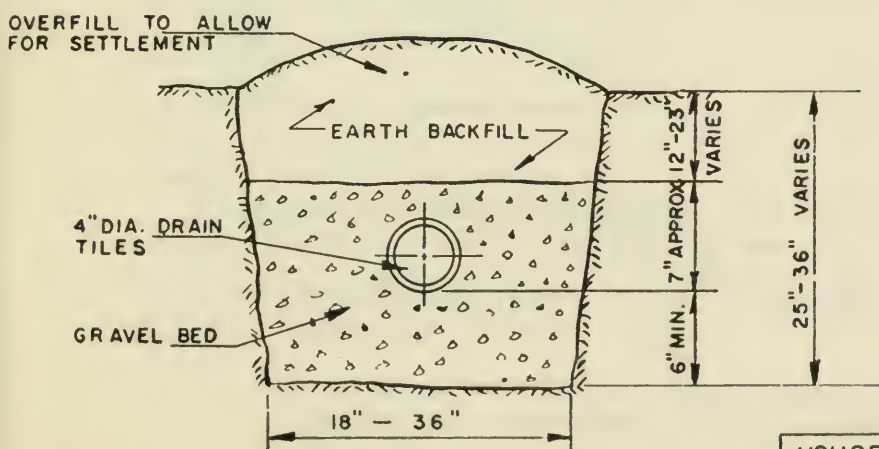
HOUSEHOLD SEPTIC TANK SYSTEMS
**SEPTIC TANK DIMENSIONS AND
 DISTRIBUTION CHAMBER DETAILS**
 NOT TO SCALE
 DEPARTMENT OF HEALTH FOR ONTARIO
 DIVISION OF ENVIRONMENTAL SANITATION
 1959



SUBSURFACE DISPOSAL FIELD - PLAN

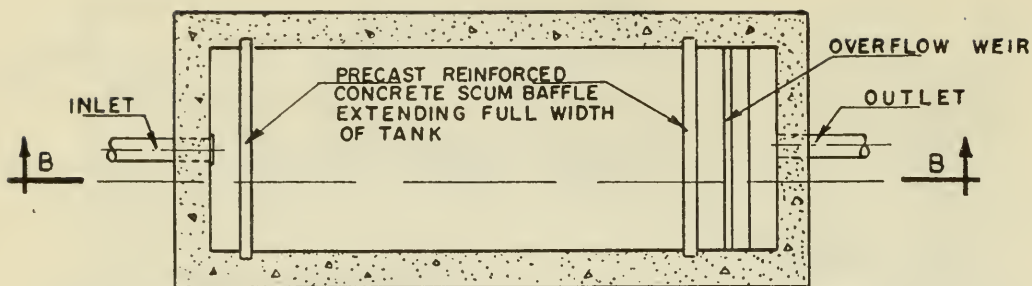


ABSORPTION TRENCH - LONGITUDINAL SECTION

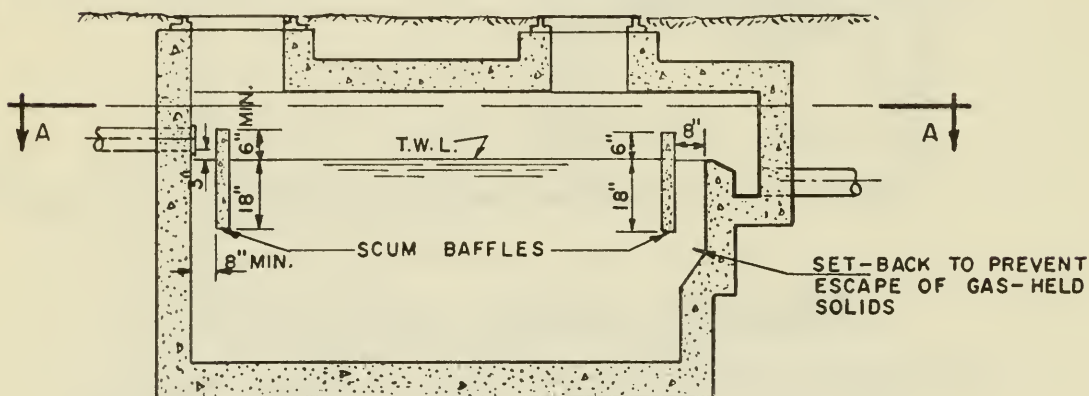


ABSORPTION TRENCH
CROSS SECTION

HOUSEHOLD SEPTIC TANK SYSTEMS
DISPOSAL FIELD AND ABSORPTION TRENCH DETAILS
NOT TO SCALE
DEPARTMENT OF HEALTH FOR ONTARIO DIVISION OF ENVIRONMENTAL SANITATION 1959

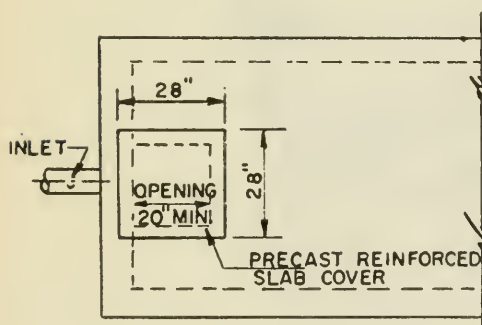


SECTIONAL PLAN A-A

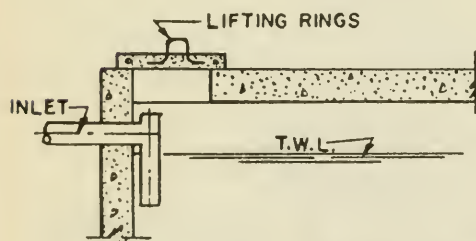
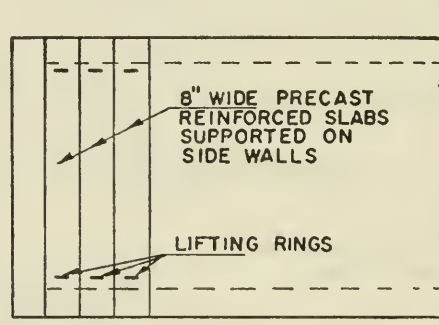


SECTION B-B

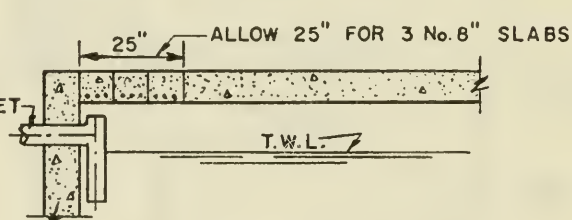
SEPTIC TANK: ALTERNATIVE ARRANGEMENT OF INLET AND OUTLET



PLAN



SECTION



ALTERNATIVE MANHOLE ACCESS OPENINGS AND COVERS

ATTENTION IS ALSO DRAWN TO THE CONSTRUCTION DETAILS SHOWN ON PLAN No. A158-8039 PUBLISHED BY ONTARIO DEPT. OF AGRICULTURE IN THEIR "CANADIAN FARM BUILDING PLAN SERVICE".

HOUSEHOLD SEPTIC TANK SYSTEMS
ADDITIONAL DETAILS
NOT TO SCALE
DEPARTMENT OF HEALTH FOR ONTARIO
DIVISION OF ENVIRONMENTAL SANITATION
1959

P A R T I I

10. Larger systems for schools, motels, hospitals or other small communities

The principles of operation and design for larger septic tank systems are exactly the same as those for small domestic systems; the only difference is that the water usage per person and consequently the volume of sewage per person is found to vary according to the type of establishment. In order to find out how much sewage is to be treated in an installation it is necessary to know the maximum number of people in daily occupation, and the average quantity of sewage to allow for each person. The table below gives the average quantity of sewage per person for modern living conditions in Ontario for various types of institutions. These figures however should be used with caution and modified as necessary if there is reason to suppose a greater or lesser water usage might occur in a particular instance. For example, at a day school with a cafeteria and showers 20 gallons per person per day might be used rather than 15.

Swimming pools	10 gallons per person per day
Recreational areas or parks with washroom facilities	10 " " " " "
Golf and country clubs (non-resident)	10 " " " " "
Day schools	15 " " " " "
Motels, tourist camps	35 " " " " "
Domestic (no washing machines)	50 " " " " "
* Domestic (with washing machines but no garbage grinders)	60 " " " " "
Domestic (with washing machines and garbage grinders)	72 " " " " "
Hospitals	150-250 " " " " "

*) *This is the basis used in compiling the Table on Drawing No. 3, Page 10.*

Knowing the number of people who will use the installation and the average sewage quantity per person, the total daily quantity of sewage to be treated can be found. The required liquid capacity of the septic tank is calculated as follows:

- For tanks up to 2,000 gallons capacity allow for 1½ times the daily flow.
- For tanks over 2,000 gallons capacity allow for three quarters of the daily flow and add 1,000 gallons.

These figures allow for the volume of sludge in the tank.

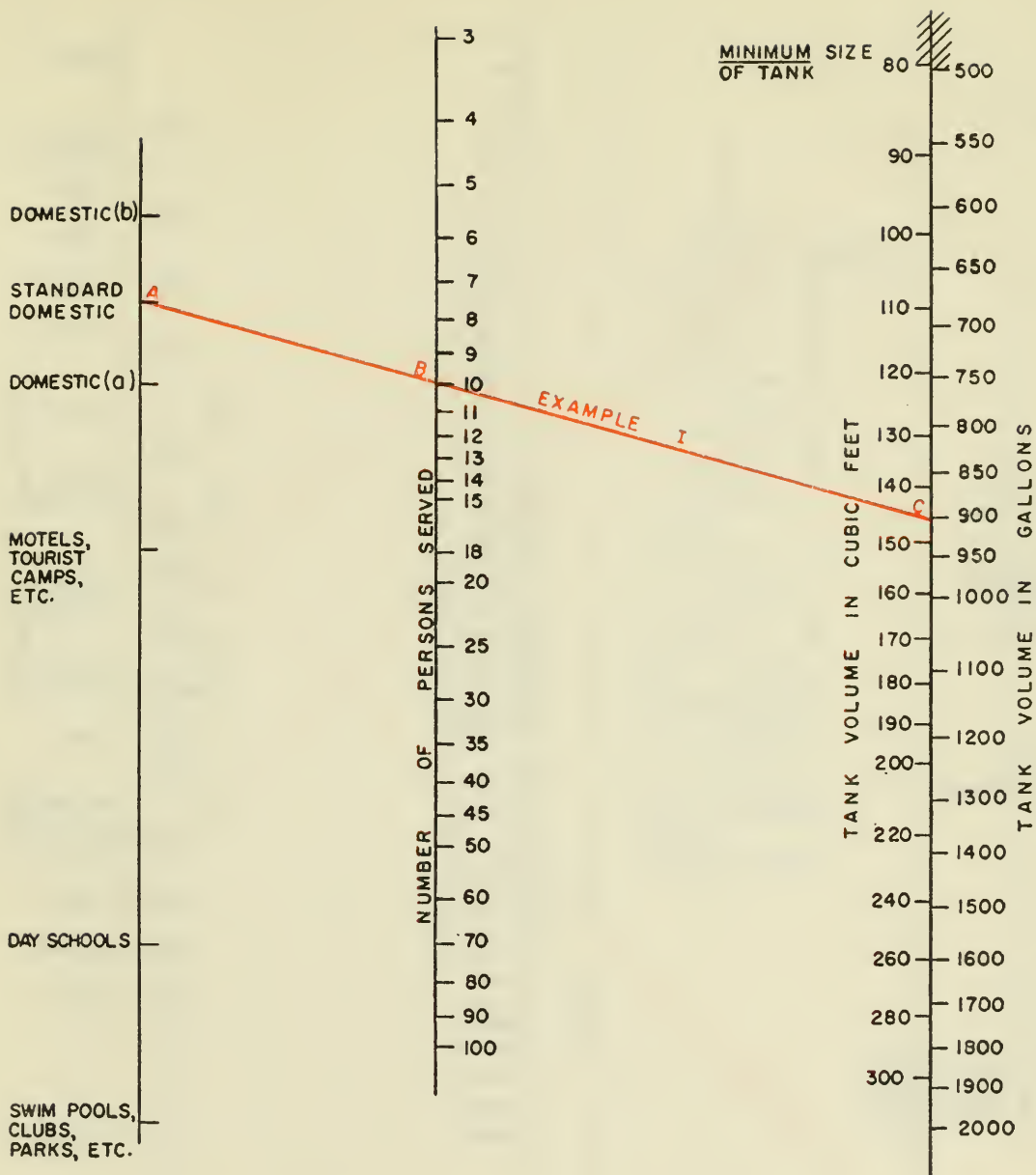
The length of tile trench required is found after carrying out the soil percolation test as described in section 6 of Part I. The following table then enables the required area of trench bottom to be found. This can then be converted to length of tile run according to whether the trench is 18 inches, 2 feet or some other width.

Times "t" in minutes for water to fall 1"	Length in feet of 18 in. wide trench per 1,000 gallons of sewage	Loading of tank effluent in gallons per sq. ft. of trench bottom
1	160	4.2
5	350	1.9
10	510	1.3
20	740	0.9
30	830	0.8
40	950	0.7
50	1110	0.6
60	1330	0.5
over 60	Not suitable for subsurface absorption	

The charts on the following pages enable the essential design data to be read off directly, once the number of persons, the type of establishment and the time "t" in the soil percolation test are known. These charts can also be used to read off directly the adjustment necessary for dwellings which do not have automatic washers, or for dwellings which have garbage grinders in addition to automatic washers.

If it is required to check these adjustments arithmetically, the following factors should be used:

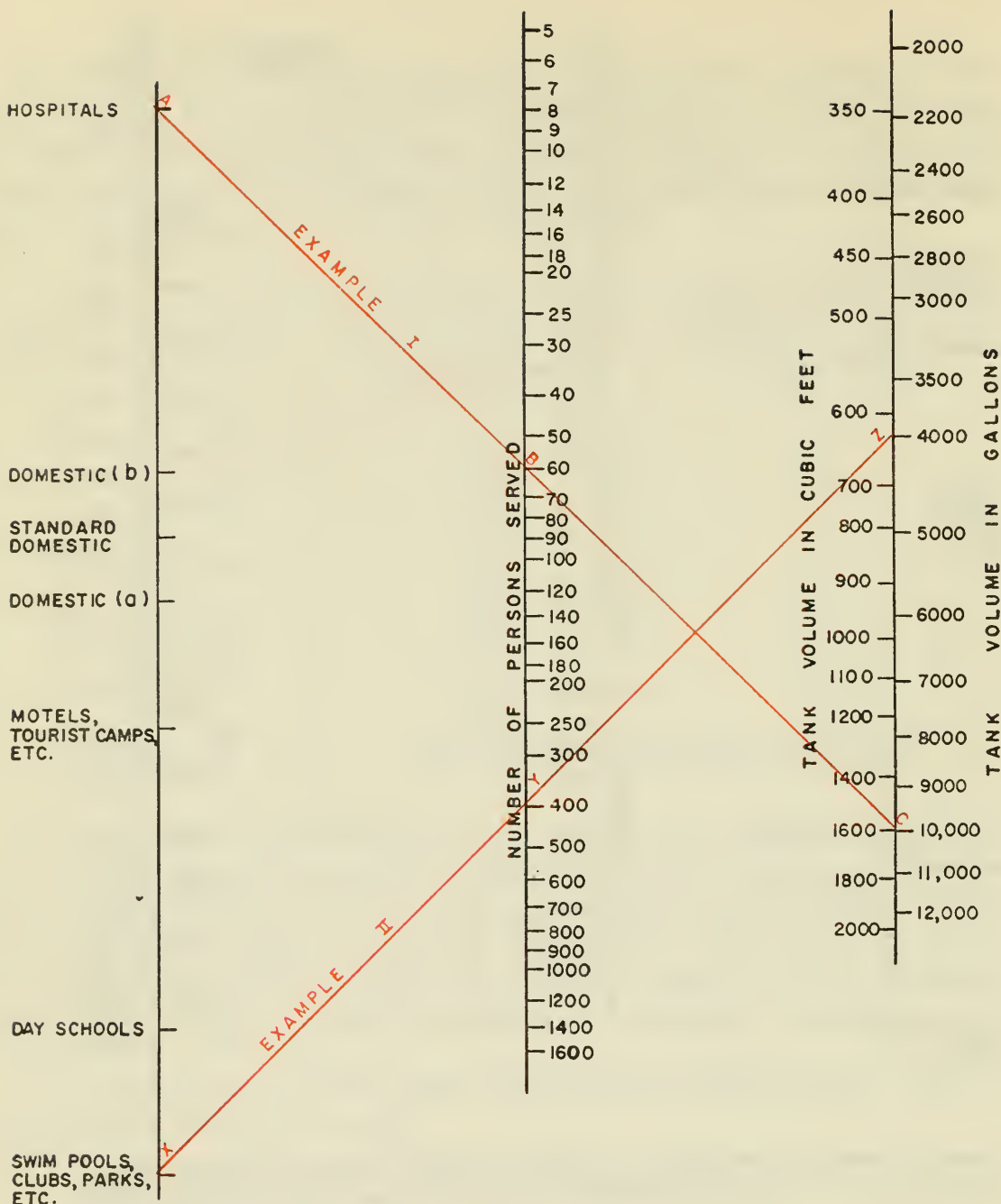
- Septic tank capacity should be increased by 20 per cent if a garbage grinder is used.
- Septic tank capacity may be decreased by 20 per cent if no washing machines are used.
- The tile trench area should be increased by 33 per cent if garbage grinders are used.
- The tile trench area may be decreased by 20 per cent if no washing machines are used.



Standard Domestic : Household with washing machine but no garbage grinder
 Domestic (a) : Household with no washing machine and no garbage grinder
 Domestic (b) : Household with washing machine and garbage grinder.

Example I : A household (A) with washing machine but no garbage grinder for 10 people (B). Line through A and B to C. Read tank volume at C = 900 gallons or 144 cu.ft.

HOUSEHOLD SEPTIC TANK SYSTEMS
SEPTIC TANK SELECTION (FOR DOMESTIC AND OTHER SMALL TANKS UP TO 2000 GALLONS)
DEPARTMENT OF HEALTH FOR ONTARIO DIVISION OF ENVIRONMENTAL SANITATION 1959

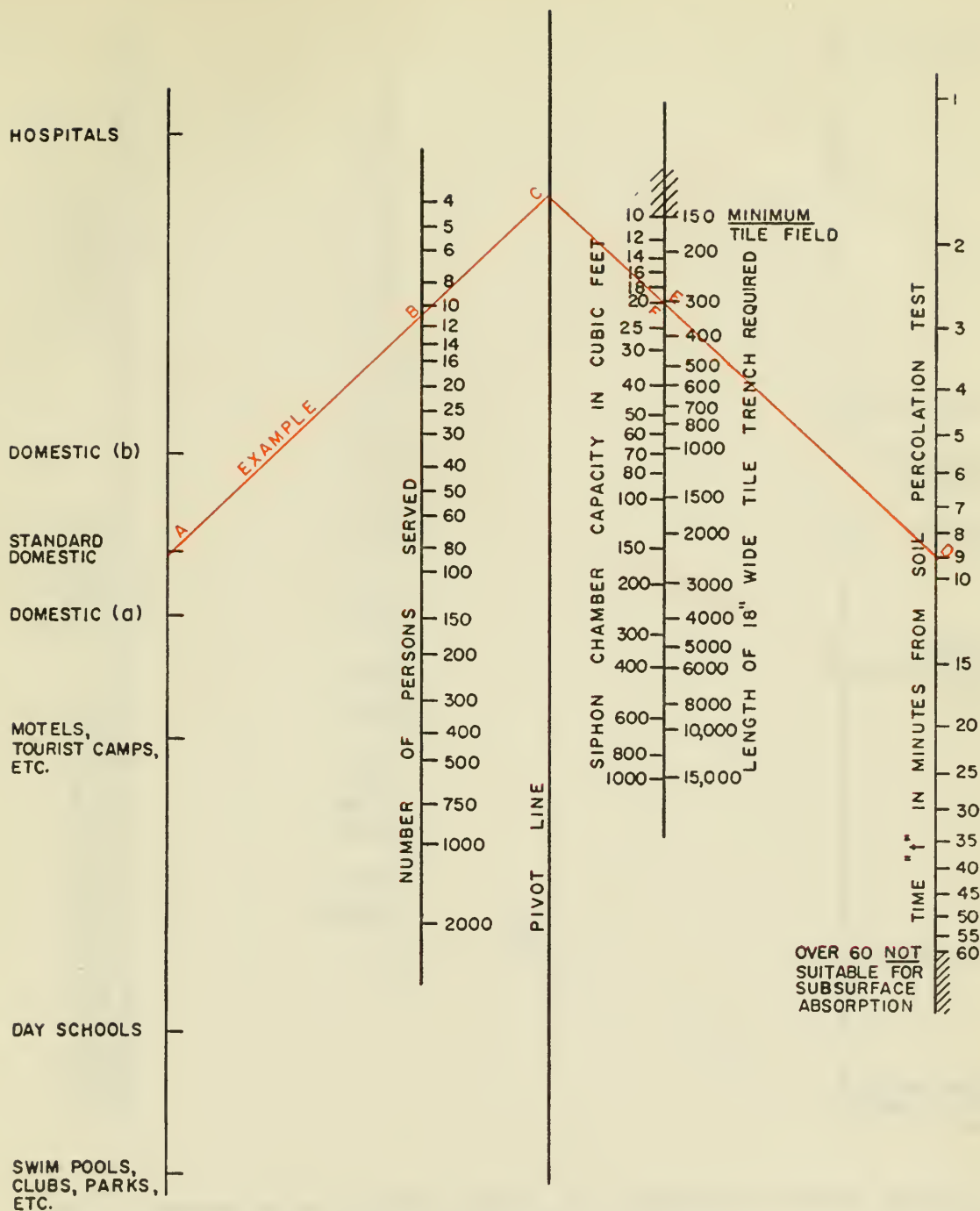


Standard Domestic : Household with washing machine but no garbage grinder
 Domestic (a) : Household with no washing machine and no garbage grinder
 Domestic (b) : House hold with washing machine and garbage grinder

Example I : A hospital (A) for 60 patients (B). Line through A and B to C. Read tank volume at C = 10,000 gallons or 1600 cu.ft.

Example II : A swimming pool (X) for maximum daily bathing load of 400 people (Y). Line through X and Y to Z. Read tank volume at Z = 4000 gallons or 640 cu.ft.

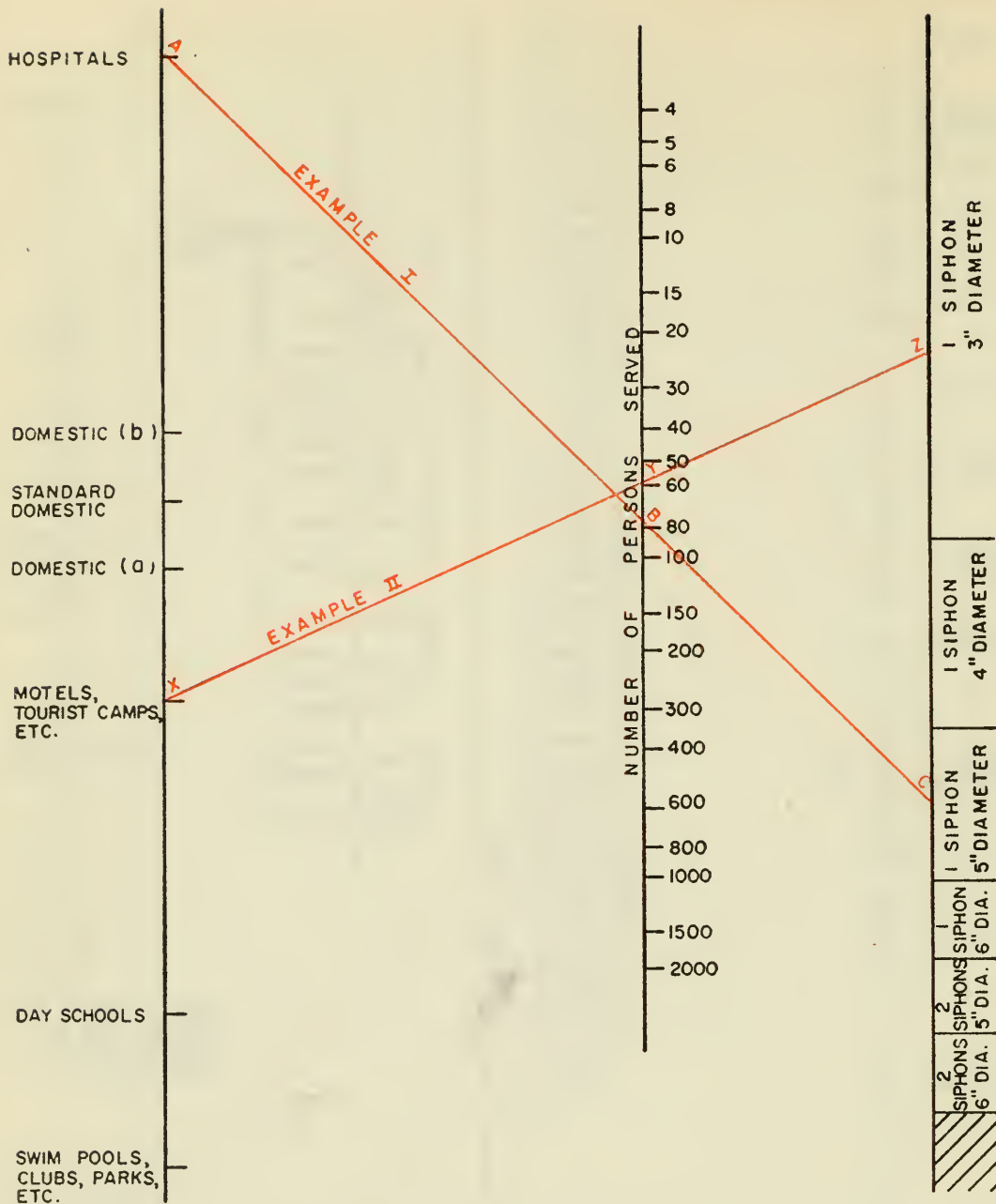
SMALL SEPTIC TANK SYSTEMS
SEPTIC TANK SELECTION LARGER TANKS (2000 GALLONS AND OVER)
DEPARTMENT OF HEALTH FOR ONTARIO DIVISION OF ENVIRONMENTAL SANITATION 1959



Standard Domestic: Household with washing machine but no garbage grinder
 Domestic (a) : Household with no washing machine and no garbage grinder
 Domestic (b) : Household with washing machine and garbage grinder

Example : A domestic household (A) for 10 persons (B). Soil percolation test time "t" of 9 minutes (D). Line through A and B to Con pivot line. Line through C to D. Read tile trench length at E = 300 ft., size of siphon chamber at F = 20 cu.ft.

SMALL SEPTIC TANK SYSTEMS
LENGTH OF 18" WIDE TILE TRENCH REQ'D AND CAPACITY OF SIPHON CHAMBER REQ'D (FOR 4" DIA. FIELD TILE)
DEPARTMENT OF HEALTH FOR ONTARIO DIVISION OF ENVIRONMENTAL SANITATION 1959



Standard Domestic: Household with washing machine but no garbage grinder
 Domestic (a) : Household with no washing machine and no garbage grinder
 Domestic (b) : Household with washing machine and garbage grinder

N.B. Two siphons in one chamber not interconnected will work alternately and thus have the discharge capacity of one siphon only. They must be interconnected to obtain the combined discharge capacity.

Example I : A hospital (A) for 80 patients (B). Line through A and B to C. Read siphon size at C = 1 siphon 5" diameter.

Example II : A motel (X) for 60 guests (Y). Line through X and Y to Z. Read siphon size at Z = 1 siphon 3" dia.

SMALL SEPTIC TANK SYSTEMS

SIZE OF SIPHON REQUIRED

DEPARTMENT OF HEALTH FOR ONTARIO
 DIVISION OF ENVIRONMENTAL SANITATION
 1959

